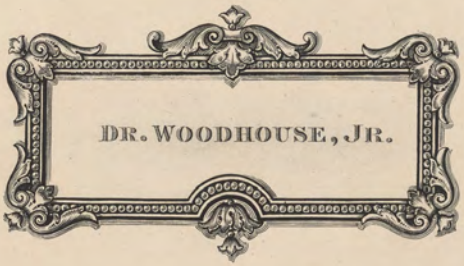
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Notes
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Lecture 31st –

Of the Metals

These are Shining, Opaque, Hard, Dry, Solid, Compact, Sonorous, Elastic, Bodies insoluble in Water and Alkohol – which are good conductors of heat & electricity, their specific gravity is very remarkable, a cubic foot of Marble weighs 190 ℔. a cubic foot of Zinc 510 ℔. and a cubic foot of Gold 1348 ℔. some add to these properties Maleability & Ductility but these are by no means general, the first is that property by which they are capable of being flattened under the hammer – the second is that by which they are capable of being drawn into wire or extended under the laminating rollers

We will now take notice of the general effect of heat & Mixture on them and here we shall be very general ——

When heated to a certain point which varies in most metallic substances they

become liquid tho' no two of the Metals fuse at the same temperature —

The Acids act on them, some dissolve others only corrode them by the solution of a Metal we mean that by evaporation the fluid will chrystallize when this is not the case it is called corrosion —

When Sulphuric Acid is added to a Metal in its concentrated state, there is an escape of Sulphurous Gas, if the Acid be diluted there is an escape of Hydrogenous gas this arises from the decomposition of the Water —

When Nitrous Acid is added to a Metal Nitrous Gas is disengaged always - this happens from the decomposition of the Acid - when Azote escapes with part of its Oxigene in form of Nitrous Gas while the oxigene oxides the Metal, and the Acid (part of which is undecomposed) dissolves the oxide, this Nitrous gas unites with more pure air from the Atmosphere

and reproduces the Nitrous Acid, the combinations of this Acid and the Metals are Potential Cauterics which are more active than the pure acid

The volatile alkali volatile oils & Alkohol act on the calces but not on the metals — Borax assists the fusion of Metals and hence is used in soldering, this consists uniting two pieces of Metals together, the solder must be compound of metals which fuse more readily than the Metal to be soldered, thus a mixture of Gold & Silver is used to solder Gold — Silver & copper to solder Silver &c — the Borax very likely acts by preventing the bright surface of the Metal from reflecting the heat —

All neutral salts may be used as fluxes they act in proportion to the pure air which they contain this by its decomposition evolves heat —

It next remains for us to say something of the Natural History of the Metals —

They exist in the bowels of the Earth - Nature has carefully concealed them, the industry and Avarice of Man are employed in digging them up and cleaning them of all impurities for they are never found in a perfectly disengaged state - Sulphur, Arsenic and some of the Earths are the most common substances found in combination with them - To separate them and other foreign matters constitutes the art of Assaying which contains every thing necessary for the Chemist to know

Heat alone is insufficient to separate these different substances, the combined operations of heat and Mixture must be used - Acids dissolve the Metals and of course are used in these operations - The Acid solution of different Metals may be known by their sensible qualities - Thus a solution of Copper is Green, a solution of Lead tastes sweet &c. - The neutral Salts are also used - Nitre projected into an ignited Crucible with Tin

and Iron filings deflagrates violently whereas if thrown by itself no deflagration ensues

Ores which contain earths are heated intensely — the earths vitrify or are converted into scoria. By Ore we mean the Metal as found combined with these impurities & foreign matters just now spoken of, but separated from its Gangue or bed in which it was found, this bed often consists of Clay, of stones of a gravelly sort &c — The Metals are often found in combination with Oxigene, they are then called oxides or calces — they are separated from this by heating intensely in contact with Charcoal — Oils &c &c — which unite with Oxigene and the Metal is reduced, that is, is converted to its Metallic state This operation is called reduction — Metals always lose weight by the deprivation of Oxigene, thus 112 Oz. of Minium or red Lead yield but 100 lb of Lead in the Metalic state

The first operation after a sufficient quantity of Metal is dug up from the Earth is to pound it, or break it into small peices, it is then washed by causing a stream of Water to pass over it, which carries of the Gangue and other light substances which may adhere to it, it is then called pure Ore – this is assayed and separated from all foreign matters – It is necessary to fuse the Ore by heat, the fluxes are such as the Sal Microcosmicus or Salt of Urine – Borax – Sandever or Sal Vitri – this Sal Vitri contains a quantity of common Salt united to Glass in powder – a very simple mode of assaying some ores in the small scale is to place it in a hole cut in a peice of Charcoal and throwing some Nitre upon it, this affords oxigene in abundance and burns the ore, Salt of Urine is recommended by Cronstadt for this purpose

but I prefer Nitre, he also says that Borax & the alkaline Salts may be used - the blow pipe is a very useful little instrument in assaying small quantities of ore, with the flame of a candle it affords a very intense heat. Charcoal is more used as a reducer of oxides, than any other Carbonaceous substance - Black flux however is very useful, as it contains much charcoal - It is composed of two parts Tartar and one Nitre, the pure air of the Nitre affists the combustion very much and gives a sufficient heat to cause the decomposition of the calx or oxide, the white flux is composed of equal parts Nitre & Tartar consequently contains more pure air -

If the Metal be mineralized by Arsenic and Sulphur too theory a heat must not be used for Realgar or Orpiment would be formed - Metallic soda answers very well for fluxes, they act as the Yeast of

Buttons, the scoria made at one time serve to flux the next quantity of ore, they consist of Glass and a Metallic oxide, the Glass is formed by the vitrification of the Earth — a better method than heat in separating Sulphur and Arsenic, is to employ a substance which has a stronger attraction to the Sulphur than the Metal; for instance if we wish to separate Sulphur from Mercury, we cannot use heat for the Mercury is as volatile as the Sulphur and would rise along with it. if on the other hand we add an alkaline Salt, the Sulphur & Alkali unite and form a Hepar which dissolves the Metal, what now are we to do — upon looking into the table of attractions we find that Iron attracts Sulphur more strongly than Mercury, We distill Iron filings with the mixture of Mercury and Sulphur, the Mercury is volatilized rises and is condensed in the receiver while

the Mixture of Iron and Sulphur remain in the retort —

Eliquation is sometimes used in the separation of Metals, it consist in applying heat sufficient to fuse one of the Metals while the other remains solid, this process is most commonly performed when Mercury is to be separated, the Mercury is volatilized and the other Metal remains in the solid form —

Water is used only to soften the Matrix or Gangue it permits their more ready separation by the subsequent operations — For this purpose the Ore is ignited and thrown into the cold Water —

With this we finish our account of Docimasia, We would not have you suppose that all the Metals must be treated in this manner some of them are found native and require only purification from their Gangue —

Lecture 32d —

The Metals just spoken of are 17 in number and divided into the Perfect the Imperfect and Semimetals —

The perfect are such as are not changed by the combined action of Air and Fire they are 3. Gold - Silver and Platina

The Imperfect are such as are changed by the Air if heated and possess Malleability and Ductility. they are 5. Copper Tin - Iron - Lead and Mercury —

The Semimetals are such as are possessed neither of Malleability nor Ductility and are alterable by exposure to the air they are 9 - Bismuth - Cobalt - Antimony Arsenic - Zinc - Nickle - Manganese Molybdena - and Wolfram ——

9 Semimetals
5 Imperfect
3 Perfect
Total 17 Metallic substances exclusive of

some new discovered ones which have been announced lately they are called Sylvanite Tetanite and Uranite —

After having enumerated the different Metals and treated of the modes of separating them from their Combinations we proceed to treat of each of them separately — of

Mercury —

Mercury is distinguished from the Metals in general — 1st By its great weight being heavier than any Metals but Platina & Gold

2nd — By its great fusibility being always liquid in the usual temperature of the Atmosphere — 3d By its great volatility being capable of assuming the gaseous form long before the point at which the other Metals ignite — It suffers no change by this process but may be condensed again by cold — Boerhaave had the patience to distill the same Quicksilver

500 times it underwent no other change than that of being converted into a grey powder which required only trituration to cause it to resume its Metallic brilliancy & Splendour

No Metal has been more wrought upon than Mercury, the Alchemists supposed it to contain Gold or rather the Seed by which they might convert the Metals into Gold - The valuable Medicines which are prepared from Mercury have also caused it to be much wrought upon - The Lues Venerea was considered as an incurable disease, till it was discovered that Mercury is its antidote —

Mercury is acted upon by a vast variety of agents — The nitric acid dissolves it with violence and impetuosity - The French Chemists have overlooked one fact in its action which is that Water is absolutely necessary the concentrated acid has little action on it —

If oxides the Metal before it dissolves it, a large escape of Nitrous gas always takes place during the action of this acid, If this solution be evaporated and the heat urged much a red Salt is obtained called Red Precipitate The Pharmacopœia direct us to add a small portion of Muriatic acid to the titrie to give it, its glistering appearance, but this is insufficient for that purpose, the secret appears to be confined to the German Chemists, by which this sparkling appearance is given to it —

If Rhubarb be triturated with Mercury the Metal loses its lustre and is killed as it is called i.e. it is intimately divided this effect is much facilitated by mixing the Rhubarb into a paste with Honey molasses - Sugar - and the like - thing all act mechanically - a mixture of honey and Rhubarb will kill as much Mercury

in two minutes as flour and the other substances would do in two hours ——

Mercury tends constantly to unite with pure Air – if a quantity of Mercury be exposed a considerable time to the Air in a shallow vessel and its temperature be somewhat raised a red oxide is formed called very improperly Mercurius precipitatus per se. ℥i of the Metal absorbs in this operation a pint of pure Air ——

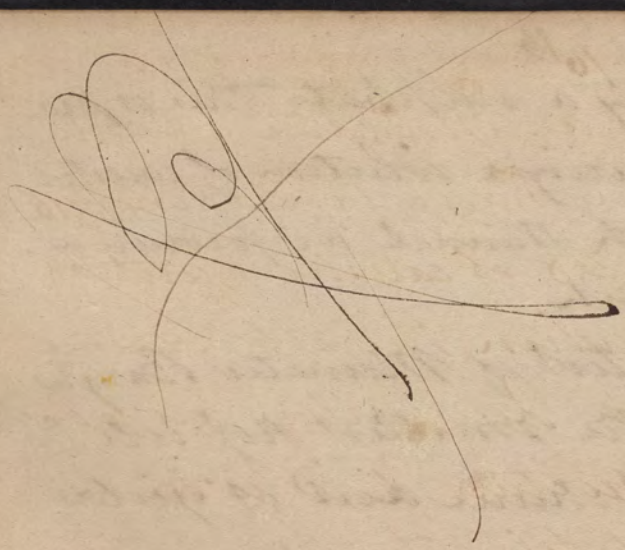
The Sulphuric Acid spirited by heat acts powerfully on Mercury. If boiling and saturated with the Metal and exposed to the cold a whitish salt is precipitated if hot water be poured on this Salt its colour is converted to a beautiful Yellow-brown by the name of Turbith Mineral the more water is added the more intense is the Yellow colour – The French Chemists consider this as an oxide of Mercury

Turbith Mineral may be made by adding the Sulphate of Potash to the Nitrate of Mercury. —

but it is certainly a sulphate this is proven – 1st By pouring a solution of caustic Potash on Turbith Mineral we procure a sulphate of Potash —

2nd By the test of Muriated Barytes which detects the smallest possible quantity of Sulphuric acid it yields a precipitate —

3 By washing the Turbith in water the acid is detected in the water by Blue Vegetables – Fourcroy says that after 5 or 6 Washings no ~~Acid~~ can be detected in the Water but I have detected it in water after the Turbith had been 20 or 30 times washed – Notice is taken of it in the Pharmacopeia Chirurgica and also in the Pharmacopeia Edinburgiensis they both consider it a sulphate under the name of Hydrargyrum Vitriolatum flavum —



Wards famous antisyphilitic and anti-venereal Drops are made by adding ℥16 of Nitric Acid to ℥8 of caustic spirit of Sal Ammoniac, when the effervescence is over ℥4 of pure Quicksilver are to be added and the mixture digested in a gentle sand heat till the Mercury is dissolved, this solution placed in a cool place chrystallizes - to every 16 ℥ of these chrystals 2 ℔s of rose water must be added, after this has stood 24 hours the solution is complete - the dose is from a grain to two ~~pa~~ day each drops contains about one grain of Mercury -

Alkaline Salts precipitate Mercury from its solution in Acids - the Nitric solution precipitated by Potash forms Mercurius Precipitatus Fuscus by the mild volatile alkali or carbonate

Merc. precip. alb. is prepared by adding a solution of carbonate of potash, to a solution of Corrosive sublimate & a solution of Sal. ammoniac here two dbl. elective attractions take place, the carbonic acid of the carbonate of potash unites to the ammonia of the muriate of ammonia and forms carbonate of ammonia, the muriatic acid of the sal. ammo. unites to the potash of the ~~carbonate~~ of potash & forms muriate of potash, the carbonate of ammonia is then decomposed & we obtain ~~muriate of ammonia~~ and carbonate of Mercury. —

of Ammonia - White Precipitate - with caustic ammonia the Mercurius Cinerius a ash coloured calx of Mercury — The carbonate of ammonia in forming white precipitate is prepared by adding to a solution of Muriate of Ammonia - Carbonate of Potash - a double elective attraction ensues, the fixed air of the carbonate of Potash unites to the Ammonia & forms Carbonate of ammonia, while the Marine acid of the Sal ammonia unites to the Potash & forms Digestive Salt of Silvius This carbonate of ammonia is to be added to the Nitric solution of Mercury and the white precipitate is formed, which is a carbonate of Mercury - If the above precaution be not used in preparing the carbonate of Ammonia the colour of the precipitate is black, how this

happens I do not know but such certainly is the fact —

Lime Water has likewise the same property of precipitating Mercurial solutions —

The Muriatic Acid acts powerfully on Mercury this combination forms Calomel and Mercurius Dulcis which differ little from each other, the Mercury must not be in a Metallic form or no action ensues — the usual mode of forming it is to precipitate a solution of Mercury in Sulphuric Acid by Common Salt or the Marine Acid the Marine Acid seizes the Mercury & forms Calomel which must be sublimed four times — By dissolving a calx of Mercury, as the red precipitate in Marine Acid (we prove that red precipitate is a calx of Mercury by heating it intensely in a Gunbarrel and receiving the Gas that is disengaged in the Pneumato Chemic Tub, this is done by connecting a Syphon to one end of the Gunbarrel while the

Calomel is commonly prepard in the following manner. Mix equal parts of the sulphate of Mercury & Muriate of soda together when exposed to heat Cor. sub. sublimes, to 12 parts of this cor. sub. add 9 parts of pure Mercury & triturate them, and Calomel is formed, this must be washed to separate the cor. sub. –

other is closed and heated) when the calx is dissolved in the Marine Acid the liquor is evaporated and the Muriate sublimed as in the other process yields Corrosive Sublimate Scheele a Chemist of Sweden has proposed a method of making Calomel by decomposing the Nitric solution by common salt – In this manner he procures a Nitrate of Soda and very good Calomel which need only be washed to be fit for use, he says it is more readily pulverized than that procured in the usual way – Chaptal lays claim to the discovery and says he communicated it to the Academy of Sciences of Paris two Years before Scheele made it public ——

Lecture 33rd –

When the Hand is immersed in running Mercury a sensation of Cold is felt this is owing to Mercury being a very good

* There is an error ~~[illegible]~~ ~~[illegible]~~ in the mode of making Tartrite Potash by the use of Red precipitate & Sulphuric acid for it is asserted that Nitrate of Potash is formed this cannot be the case as there is no alkali in the ingredients —

T. Benezet

conductor of heat and consequently conducting the heat from the hand —

The use of boiling water in the formation of Turbith Mineral is merely to wash off the surplus of acid — It may also be made by digesting Sulphuric acid on an oxide of Mercury, if the red precipitate be used as a small portion of Nitrous acid adheres to it an elective attraction ensues - the sulphuric acid unites to the Mercury and forms Turbith, while the Nitric acid and Potash unite and form Nitre* — We observed at our last Lecture that Muriatic acid digested on a calx of Mercury yields by sublimation Corrosive sublimate, this differs from Calomel in many respects - It is composed of oxigenated Muriatic acid and Quicksilver - another method of forming the Corrosive sublimate is to add equal parts of decrepitated Sea

Phosphate of Mercury is obtained by adding a solution of the phosphate of Soda to nitrate of Mercury. — This is said to produce a salivation sooner than any other preparation of Mercury. —

Salt, Green vitriol, and red precipitate together - the sulphuric acid of the green vitriol unites to the Soda of the common salt and forms Glaubers Salt, while the Marine acid of the common salt unites to the Mercury of the Precipitate, and as the precipitate contains a large portion of Pure Air the acid becomes oxigenated and dissolves the Mercury forming oxigenated muriate or corrosive sublimate which must be sublimed ——

Dr. White of this City has made some of the mild sublimate or Calomel (i.e. muriate not oxigenated) according to Scheele's method but he finds it to suit his Patients

The vegetable Acids dissolve the oxides of Mercury - the sublimates thus formed are seldom if ever used - Margraaf was the first who noticed the action of the Vegetable acids but he has discovered no useful Salts

by these combinations —

Lime Water added to a solution of corrosive sublimate precipitates it of a beautiful yellow orange colour called Aqua Phagedenica this is used to clean old Ulcers the proportions are ℥i of corrosive sublimate to 1℔ of lime water - the oxigenated muriate of Lime is formed which dissolves the Mercury —

Corrosive sublimate is sparingly soluble in Water but if ammonia be added the solution is much assisted, if to ℥ss of corrosive sublimate we add ʒ9 of Sal ammoniac and ℥3 of Water the sublimate will be dissolved and Regenerating Water or Lafecteur's Drops are formed - Disputes have arisen concerning the action of this Salt some have asserted that it acts by giving out its water of Chrystallization but this is not so as

the Water is in very small Quantity
Mercury has been called the Proteus Metallorum because after every change solution, oxidation, &c — it resumes its form of Metal by heat alone —

Mercury does not unite with any Inflamables but Sulphur simple trituration is sufficient to produce this combination the result is a black substance called Ethiops Mineral in this state it is often found in the bowels of the Earth the Ethiops sublimed affords a beautiful red Substance called Factitious Cinnabar it is used by the Painters as a Pigment under the name of Vermillion — equal Sulphur and Mercury are commonly used in this Preparation — Hoffman is the inventor of Vermillion —

Mercury readily unites with all the

Metals but Cobalt and a few others, the combinations of Mercury and the Metals are called Amalgams — Tin and Mercury form the Amalgam which is used in making Looking glasses or Mirrors — These Amalgams are of various consistence, in proportion to the Mercury they contain they are more fluid —

Mercury has never been induced solid in any other manner than by extreme cold — The Alchemists tried long to discover a method of fixing Mercury in order to find out their Alkahest or universal Solvent. this I consider as an impossibility — Thunberg very properly asks if it would dissolve all substances in what vessel could we confine it — Mr. Braum of Petersburgh has fixed Mercury by a mixture of Muriate of Lime and Snow Authors tell us that it freezes at 39° below 0

of Fahrenheit, but I have succeeded in freezing it and the Mercury remained fluid till the Spirit of Wine Thermometer descended to 30° below 0° —

We just observed that Mercury unites with most Metals - Iron is an exception unless Alum is used the Method of forming an Amalgam with Iron consists in pulverizing ℥i of Alum with ℥ss. of Iron filings and adding ℥iij of Mercury the combination takes place and the Alum is washed off by Warm Water - In consequence of the facility with which Mercury unites to the Metals it is often adulterated with Lead and Bismuth, with Bismuth it forms a fluid alloy - Lead is detected in it by dissolving it in Acetic Acid, Sugar of Lead is formed which is known by its sweetish taste - Bismuth by solution in Nitric Acid & the addition of Water - Spanish White or Magistery of Bismuth is formed when the Water is added —

Lecture 34th —

The air procured from the Red precipitate at the last Lecture yields an absorption of 170° by the Eudiometer - this is tolerably pure -

The Mercurial preparations just described possess a very stimulating property not only of accelerating the Circulation in general but also of causing an increased secretion of the Fluids more especially the Saliva producing salivation &c - the Mercury in its crude state has but little or indeed no action - Calomel increases the secretion of Mucus in the Intestines & so produces purging -

Dr. Cullen has disproved the opinion of Dr. Dover that Mercury has some action in its Metallic state —

If Mercury be triturated by rubbing it with hogs lard the Mercurial Ointment is formed, this being rubbed on the Skin

produces Salivation in the same manner as the Mercurial preparations just described some use Turpentine to facilitate the killing of the Mercury but it is a bad hand as it irritates the skin very much —

The Pills made by rubbing Quicksilver with Honey and Rhubarb (commonly called the blue pill) may be given in the dose of from 6 to 12 Grains per Diem —

Plenck a Physician tho' no Chemist has found out a mode of killing Quicksilver by a Mucilage of Gum Arabic, this is called Plenks solution - he betrays his ignorance of Chemistry by supposing an attraction existed between the Gum & Metal

The celebrated Theyers pills are formed, by dissolving a calx of Mercury in Acetic Acid, or decomposing a Nitric solution by Acetate of Potash according to the London Pharmacopeia —

Chings lozenges are compound of Calomel & Sugar, the brown of Cal. Jalap & Sugar. —

Some of the preparations of Mercury possess the property of fulminating such are Mercurius Cinnius, the precipitate of Aqua Phagedenica &c &c — — —

Mercury by distillation is separated from all its Amalgams —

With Gold it forms an Amalgam hence when a Person who wears a Gold ring suddenly grows fat the ring cannot be separated from the finger, the finger often inflames and becomes painful — this is remedied by rubbing the ring with Mercurial ointment or some other preparation of Mercury, this renders the ring brittle and by striking it gently with a key or something of the sort, it breaks off —

A Borate of Mercury has been mentioned by a Doctor of the Dijon Academy but it possesses no new properties —

Doc. Clutterbuck has proposed Mercury to cure the poisonous effects of Lead his merits is as yet unknown —

Boerhaave tyed a bottle containing Mercury to one of the Wings of a Windmill and there letting it remain for the space of 14 years, upon examining the Mercury no visible change was perceivable — Mr. Saunders has repeated the experiment in a different manner he fastened a vial containing 1lb of Mercury mixed with some Iron filings to the Wheel of his carriage, when the carriage had gone 400 Miles the Mercury was oxided in form of a gray powder — the reason of Boerhaaves merits is that the polished glass surface suffered no friction with the Mercury, The Iron filings in Mr. Saunders experiment did away this objection ——

We have now enumerated the most common preparations of Mercury and given

directions how to prepare them – to wit 1 Mercurius precipitatus per se – 2d Merc. precip. Ruber – 3d Merc. precip. Album 4th Merc. precip. Fuscus – 5th Merc. Cinerius – 6th Calomel or Merc. Dulcis – 7th Merc. Corosiv. Sublim. – 8th Ethiops Mineral & Cinnabar – 9th Turbith Mineral – 10th Aqua Phgedenica – Plenkes solution Huyers Pills – the various Amalgams &c &c – little more remains to be said on the subject excepting its Natural History ——

Mercury is found in Hungary, Spain the East Indies and various parts of the Universe – Immense quantities are annually exported to Peru in order to separate Gold from its Ores the Mercury unites to the Gold and is afterwards separated by heat – It is found – 1st In the interstices of Rocks, in a native form 2nd In globules in its own ore — and 3rd in form of Ethiops and Cinnabar, for a particular account of the Method of Separating, refer to the Common books of Chemistry – It is

often found in Mountains of Chalk and other calcareous Stones — We pass on & consider —

Antimony —

Basil Valentine is one of the earliest Writers who treats of this Semimetal — he had observed that some Hogs to whom he had given Antimony became very fat, being Prior to an Abbey he proposed to the Friars to fatten themselves in this manner — They unsatisfied with their present lank condition readily yielded to his Project — The effect however was widely different on the Holy Brotherhood for those venerable Fathers all died in a short time — hence it derives its name from two French words Ante against and Moien Monk or Friar —

No substance has been more wrought on than this Semimetal. Lemery describes not less than 200 preparations of it to name which would be tedious and disgusting —

The pure Metal is obtained by heating the ore in a Crucible, it fuses & runs to the bottom of the Regul in form of a Crown with a Star on its surface called Regulus of Antimony from its resembling the Crown - the Star on its surface is a curious phenomenon and must be attributed to its regular chrystallization - it has the Metallic brilliancy and opacity which tarnishes by exposure to the Air ——

Antimony fuses with a red heat, if the heat be gradually increased and long continued the Semimetal evaporates in form of a white calx which may be collected in the manner which will be described when we come to treat of Zink - if the heat be still more violent the Semimetal is vitrified, runs into a red semitransparent glassy oxide, called glass of Antimony - if this glass be finely powdered and thrown

into fused Beeswax it forms Vitrum Ceratum Antimonii so much extolled by Sir John Pringle in Dysenteries — He makes it by fusing ℥i of Bees wax and stirring in ℥i of the impalpably powdered glass of Antimony

The Sulphuric Acid highly concentrated acts upon Antimony with an escape of Sulphurous gas the Acid must be heated to produce this effect — The Nitric acid also acts on Antimony — but the

Nitro Muriatic or Aqua Regia is its proper Solvent and here it has the honour of being on a footing with Gold itself —

The oxigenated muriatic dissolves it forming butter of Antimony. the usual mode of procuring the Butter of Antimony is to distill corrosive sublimate & regulus of Antimony together and not to dissolve the Metal directly in the Acid — It is a violent

Caustic and is much used as an Escharotic
Water decompows the oxigenated muriate of
Antimony by diluting the Acid, the Anti-
mony is precipitated in form of a white
Powder called Powder of Algaroth or Mer-
curius Vitæ this name is very improper
because no Mercury exists in it and becaus
it is highly caustic and might much more
properly be called Mercurius Mortis as
it would certainly destroy Life —

Nitric Acid added to Butter of Antimo-
ny forms Bezoar Mineral —

The vegetable acids act on this Semimetal
The Acid of Tartar forms a well known
compound called Tartar Emetic or in the
new nomenclature Antimoniated tartrite
of Potash, as it is made with the acidu-
lous tartrite of Potash or Cream of Tartar
This is mixed with equal parts of powde-
red Antimony, moistening them with Water

boiling and chrystallizing — Authors differ with respect to the preparation of Antimony for the formation of this Salt — some direct Crocus Metallorum, some Powder of Algaroth &c &c — (See Chaptal)

Tartar Emetic acts in different doses in different places, 2 grains act at Montpelier in 11 Grains are requisite

The Apothecaries treat us and moistin vitriolated Tartar with a solution of Emetic Tartar which they call for Tartar Emetic

The usual mode of prescribing it here is ℞ Tartar Emetic gr. 4 dissolve in 6 table spoonfuls of Water (boiling) to give a Table spoonful every 15 Minutes —

Lecture 35th —

Since our last Lecture Dr. White of this City has informed me, that he used the following method of preparing White Precipitate, to a solution of mild

Vegetable Alkali is added a solution of Sal Ammoniac a double elective attraction ensues, the Carbonic Acid of the Potash unites to the Ammoniac and forms Carbonate of Ammoniac, while the Marine acid unites to the Potash and forms Digestive Salt of Silvius - The Carbonate of Ammoniac is added to a solution of Corrosive Sublimate another double elective attraction ensues, the fixed Air of the Ammoniac unites to the Mercury and forms Carbonate of Mercury or White Precipitate, while the oxigenated muriatic acid of the Corrosive Sublimate unites to the Ammoniac and forms Oxigenated Muriate of Ammoniac - this tho' a dear is a far preferable method, —

To return to Antimony

Doctor Cullen says this Demimetal in its metallic state is inert, but

he is certainly wrong for the perpetual pills which are nothing more than Antimony cast into moulds are purgative - there are called perpetual pills because they may be kept from Generation to Generation without alteration —

Of the Inflammable substances Sulphur appears to have the strongest affinity to ~~Antimony~~ Antimony, it is always united with it in the bowels of the Earth - a small quantity of Arsenic also exists in Antimonial Ores

The Acetic Acid highly concentrated, such as is procured from distilling Verdigris or Sugar of Lead - dissolves Antimony - It is sufficient to heat equal parts of the Acid and Metal together to effect the solution —

According to Marggraf Antimony unites to all the Metals but Gold he has formed an Amalgam with Mercury & Antimony —

The most common Ore of Antimony met with is the Sulphureous this consists

of nothing but Sulphur an Antimony except a very small portion of Arsenic, this is a black mineral which soils the fingers it is compond of Needle like stria or layers of chrystals, is hard brittle and ponderous — This ore is often used as a Medicine, the difference in the opinions of of different Authors is owing to the different portions of Arsenic which their different specimens contain — A slow heat is used to separate the Metal from its Sulphurous ore, some add other metals to unite with the Sulphur, Lead is used for this purpose — Alkaline Salts are sometimes used but they are liable to the objections we mentioned when on the modes of Assaying viz. — They form Hepar Sulphuris with the Sulphur which dissolves the Metal — Some use Acids which dissolve the Antimony the Metal is

precipitated in form of an oxide which may be readily revived by heat in contact with Charcoal - the simplest method is gentle heat as we before said it must belong continued for the Sulphure is much more difficult of fusion than the Regulus - Marine acid you recollect dissolves the Antimony forming butter hence an ingenious mode of decomposing the Ore has been invented by adding Corrosive sublimate - the acid of the sublimate unites to the Antimony and forms Butter of Antimony while the sulphur unites to the Mercury and forms Cinnabar or Ethiops Mineral ——

The solution of Antimony in Hepar Sulphuris forms Kermes Mineral if red and if of a more yellow colour it is called Sulphur Auratum Antimonii or Golden Sulphur of Antimony, it is

called much more properly in the new Nomenclature a red or yellow sulphurated oxide of Antimony - Glauber first described the process for making it he says the Alkali used must be Vitriolic fixed by Charcoal i.e. pure Potash ——

Kermes Mineral first became celebrated for the wonderfull cures it performed in the hands of Simon Chartreux Friar hence it is also called Powder of Chartreux The French Physicians think very highly of it - the English very seldom make any use of it - Chaptal tells us of a quack that performed by those who prepare it in France - They sell powdered Muskdust moistened with a solution of Tartar Emetic for it. the Apothecaries who buy their Medicines at the Fair of Beaucaire vend this pernicious preparation to their customers for the true Powder of Chartreux

Of the Neutral Salts Antimony alone acts on the Antimonial Ore, Thurnsael directs to use 1 part of Nitre to 16 of Antimony - they are to be thrown into a Crucible ignited to redness, the Nitric Acid is decomposed its oxigene supports the deflagration, its alkali remains and must be washed when the pure Antimony is obtained, this is perhaps as simple a method of purifying the Ore as any we are acquainted with - a also to fuse 12 parts Antimony 6 of Tartar and 8 of Nitre in a Crucible some add Iron filings - Tin clippings &c - but they are of little use the fused Metal is to be poured out into another Crucible and the Regulus is obtained pure - Chaptals mode is very simple also viz. to fuse the Ore by a slow heat in a Crucible with a hole in the bottom the Mineral as it fuses runs down into

another Crucible underneath ——

Equal parts sulphurous ore of Antimony and Nitre forms the Sulphurated oxide of Antimony — this is a very acid powerful emetic, it acts in very small doses — This or the Glass of Antimony digested in Wine forms the Antimonial or Emetic wine, the Dispensatories are accurate in the proportion of the ingredients but this is needless for the Wine dissolves only a certain portion of the Metal and no more tho' it be digested on it for Ages, this proportion varies as to the Acidity of the Wine —

Three parts of Nitre and one of Antimony calcined form Diaphoretic Antimony

James's Powder is composed of a Calx of Antimony and Phosphate of Lime according to Pearson who has communicated his analysis to the Royal Society

of London (see their Transactions for 1791) They have slain their Thousands, among their victims may justly be reckoned the celebrated Goldsmith, the philanthropic Howard and the late illustrious Duke of York ——

A Golden sulphure of Antimony may be made by digesting Lime Water upon Crude Antimony ——

Different names have been given to the Regulus of Antimony according to the different Metals used in separating it from its Ore thus we have the Regulus Martiales when Iron is used, Regulus Joviales when Tin, Regulus Veneris if Copper, Regulus Saturni if Lead &c —

Zinc

Zinc is a Semimetal of a whitish

Colour somewhat inclining to Blue, which tarnishes if exposed to the air, if broken exhibits a chrystallized texture, fuses with less than a red heat and if heated to about the 700th Degree of Farenheits scale it emits white fumes which when collected are called Nihilum Album - Pompholix - Flowers of Zinc or Philosophical Wool first denoted by De Haen they are an oxide of Zink made by igniting a Crucible throwing some small pieces of Zinc into it and covering it with another Crucible so placed that free access of Air may be had to the Zinc - the Flowers rise and are condensed in the upper Crucible ——

Sulphuric Acid dissolves Zinc forming a chrystalizable salt of a white Colour called White Vitriol or Sulphate of Zinc -

The Acid must be diluted with water in order that it may act for no action takes place if concentrated Acid be used, as soon as Water is added an escape of Hydrogenous gas is perceived —

Nitrous Acid acts also on Zinc, if the Acid be cold it merely oxides it, but if heated dissolves it and forms a Nitrate with an escape of Nitrous Gas —

Marine Acid acts with equal violence and an escape of Inflammable Air —

Phosphoric Acid digested on Zinc gives out its pure Air and is converted into Phosphorus —

Country Practitioners who have not the convenience of Furnaces & Crucibles and wish to make the flowers of Zinc may accomplish their purpose by adding Potash to a solution of White Vitriol this gives them an oxide much resembling the flowers of Zinc

Nitre assists much the oxidation of Zinc - Nitre and Zinc thrown into an ignited Crucible detonate in a most violent manner —

Volatile Alkali digested on Zinc gives out Hydrogene Gas, the fixed Alkali give it a Yellow colour —

Zinc has no affinity to Sulphur and so strong a one to pure Air that any degree of heat is insufficient to seperate the Oxigene from Flowers of Zinc —

Lecture 36 —

These Flowers are used as a Vermifuge 1 grain is given at first and is to be increased to 5 or 6 per Diem —

Zinc unites with all the Metals but Bismuth and Nickel with Tin and Lead it forms Pewter - with Lead and Bismuth Printers Type Metal -

with Copper it forms Brass — Zinc, Brass and Tin form Bronze or Bell metal — Pinchbeck and the other Metals which resemble Gold are formed of different proportions of Copper and Zinc —

Zinc is found in many parts of Europe and India — 1st in form of an oxide 2nd Combined with Iron — 3rd with Clay forming Lapis Calaminaris — 4th Combined with many foreign substances the principal of which are Lead & Arsenic in form of Blende — also in many other Ores

Doc. Ryan has given Flowers of Zinc in cases of Asthma with success —

In the Edinburgh dispensatory we are directed to put 1 ounce of Zinc in the Crucible at once but this precaution is not necessary

Bismuth

Bismuth or Tin Glass is a hard

heavy - compact, brittle, sonorous, elastic Metal, easily pulverizable, fuses in less than a red heat, occupies a less space when in a fluid than solid form, if the heat be further urged the Metal is oxided, and if still more intense it vitrifies - the glass resembles very much the glass of Antimony and is used to flux some of the Metals for which purpose it is well adapted ——

Sulphuric Acid does not act on Bismuth in the cold but when boiled upon it there is an escape of Sulphurous gas and the Metal is corroded ——

Nitrous Acid dissolves Bismuth and is its proper solvent, it unites rapidly with it (if diluted) and forms a Salt - a large quantity of Nitrous and a whitish gas which I cannot account for escapes - the nitric solution of Bismuth is colourless and transparent - Spirit of Wine -

Alkaline salts and Water precipitate the Bismuth in form of a white oxide which is used as a Cosmetic by the Ladies who call it Pearl White, Spanish White, or Magistery of Bismuth – It is a very dangerous application and very improper to be used as a Cosmetic for it creates many Nervous Diseases, and what is of more consequence to the Ladies gives their skin a yellow hue after it has been used a considerable time – It has a contrary effect on the hair which it turns to a beautiful black – If to a solution of Bismuth in Nitric Acid be added a solution of Sea salt, a reddish yellow precipitate falls down, this evaporated to a thick consistence yields a good Sypathetic Ink if diluted with water the Letters are imperceptible in the cold, but if heated are very distinct ——

Phosphorated and Sulphurated Hydrogene Gas which is disengaged from Livers the Gas disengaged from Hepar Sulphuris and Onions detect the Magistery of Bismuth on Ladies Faces, by turning it Yellow —

Muriatic Acid acts feebly on Bismuth, it must be digested on it a long time before the Bismuth is dissolved, if water be added to this solution a Magistery of Bismuth is formed which resembles that from the Nitric solution in many respects —

Bismuth unites with some of the Inflammables more especially Sulphur it unites with almost all the Metals — with Mercury it forms a fluid alloy and our ingenious Apothecaries often adulterate their Mercury with it, to detect this in Mercury it is sufficient to dissolve the Mercury in Nitric Acid and add Water if the Mercury contains Bismuth a white

Precipitate falls down, it is necessary that the solution have be made in the cold —

Bismuth fused with Lead and added to Mercury forms a very fusible alloy which liquifies in boiling Water the proportions are 2 of Lead 10 of Mercury and 1 of Bismuth —

Bismuth like Zinc is used to give hardness to Metals, like it, it enters into the composition of Printers Types —

The vegetable as well as Mineral acid act on Bismuth, the Acetic takes up more of it than the others, they are all purgative when impregnated with it — the Acetite and Tartrite of Bismuth are highly recommended as purgatives by Schroder in the Pharmacopeia of Strasburgh —

Beame has prescribed Magistery of Bismuth in three cases of Intermittents with advantage ———

Bismuth is seldom found in a native

state, it is usually mineralized by Sulphur and Arsenic, and is also found combined with many Metalic substances more especially Cobalt — Mr. Boyle recommends heat to Separate the Sulphur ——

Lecture 37th —

Cobalt — This semimetal is found in the bowels of the Earth combined with Arsenic, Nickel and Sulphur, this Ore of Cobalt is very frequently found in chrystals — some of its ores contain Iron &c — when the cobalt is separated from those foreign matters it is a semimetal of a grey Colour very brittle and fixed in the fire not very fusible does not unite with Mercury and unites Cupellation —

The calx of Cobalt called Zaffer, mixed with three parts of sand and one of Potash fused, powdered and sifted forms Smalt —

The Smalt is put into Casks filled with Water and pierced with three Apertures, at different heights. the Smalt is agitated in those casks and drawn off. the lightest and best floats nearest the top and is drawn off at the first Cock called Azure of the first fire, that from the second cock is called Azure of the second fire and that from the third Azure of the third fire, and are of different degrees of finenes - This Smalt (being a glassy oxide) is used to paint Poulaine -

The Nitric Acid does not act on Cobalt in the Cold - but when heated dissolves it rapidly - this solution is of a beautiful Green colour and may be used to write with as a sympathetic Ink - but

Aqua Regia or Nitro Muriatic Acid dissolves the Cobalt and forms the sympathetic Ink in a more perfect manner The solution must be chrystalized and

the Chrystals dissolved in Water, the Letters written with this Ink are invisible in the cold but if held before the fire assume a beautiful green colour - Fire Screens painted with this appear to be perfectly white in the Cold but when heated assume a beautiful colour - Leaves of Trees painted with it and the branches with brown Paint appear like winter in the Cold and Spring by the Fire

Cobalt unites with all the Metals but Bismuth and Mercury -

It is procured from its Sulphurous and Arsenical Ores by heat, the Sulphur & Arsenic sublimes - the Calx which is often found is separated from its pure Air by heat - the Cobalt is found in the bottom of the Crucible in form of a Regulus or Metallic button - The Cobalt which we meet with in the Shops is nothing more than

the Arsenical Ore. this is ascertained by throwing it on hot coals when a distinct smell of Garlic will be perceived —

Arsenic —

Arsenic is a yellowish compact brittle semi-Metal, which is volatilizable by an intense heat —

It has been lately found in Virginia combined with Sulphur so as to form Orpiment —

It is frequently found native in Mines of Cobalt, & almost always exists in the Cobalt ores —

Nitric Acid acts on Arsenic — if it be frequently distilled from the oxide of Arsenic a very fuming and concentrated Nitric Acid is obtained, after which the Acid of Arsenic is procured —

Muriatic Acid may be made to unite with Arsenic by distilling equal parts of Corrosive Sublimate and Orpiment together the Marine acid of the Corrosive sublimate unites to the Arsenic and forms the oxygenated

Muriate a butter of Arsenic - while Ethiops Mineral is formed by the union of Sulphur and Mercury ——

A mixture of Arsenic and Lead afford a flux for the most refractory Earths ——

Arsenic has a stronger affinity for Sulphur than any of the Metalic substances - the combination of Arsenic and Sulphur is known by the Name of orpiment if Yellow and Realgar if Red - some have supposed the difference of colour to depend on the different proportions of the ingredients but this Idea is false for one may be converted into the other by heating it more or less intensely ——

Arsenic is a most violent poison and yet is used by the East Indians as a purge they form Cups of it which they fill with vinegar and lemon Juice & suffer it to stand for several hours & then drink it —

Arsenic unites with many of the Metals which become brittle by their union with it, tho' in less quantities it hardens them, Copper is hardened in this Manner Lewis says he united it to Gold & Platina it also renders Metals white if fused with them - Arsenic may be detected by this property; if a Mineral is suspected to contain Arsenic be put between two polished plates of Copper and the edges of the plates well luted and the whole be exposed to a strong heat, the Arsenic colours the Copper white if the Mineral contains any - it may also be detected by throwing the Mineral upon hot coals when a strong smell of garlic will be perceived - In the humid way by Cuprum Ammoniacum which is immediately turned green by Arsenic —

Oxide of Arsenic is soluble in 16 times

its weight of hot water and 18 of Cold, also in between 70 & 80 parts of boiling concentrated Alkohol — A solution of Potash dissolves oxide of Arsenic - Fowlers solution is made by dissolving 64 Grains of Arsenic in a pound of distilled water in which an dissolved 64 Grains of pure fixed vegetable Alkali this solution is used as a Tonic, the dose is 10 Drops for an Adult, proportionally less for a Child, the powder is given in the dose of an eight of a Grain —

Arsenic is found in many parts of the world, in Germany France and its Neighbourhood &c — The Inhabitants call the Ore Mispickel, the Arsenic is separated by simple sublimation, a Furnace is used in this operation which terminates in a long conical chimney perhaps 300 feet long to the sides of these Chimneys the Arsenic adheres and is scraped off — If it contains

Mr. Sage recommends Vinegar

much vitrifiable Earth Potash is added to it—

The poisonous effects of this Semimetal are best overcome by the white of Eggs — Olive oil, Milk and the like bland substances — A French Physician by the name of Navier has prescribed Hepar Sulphuris as an Antidote but this is merely from Theory —

Manganese

This is a semimetal always found combined with Oxigene and difficultly reduced to the Metalic state, it is of a black colour soils the Fingers, and is used in the Glass houses under the name of Soap of the Glass Makers it whitens the Glass by virtue of the pure air it contains — To procure it in the form of a Metal, Chaptal directs us to line a Crucible with Charcoal, a hole is to be cut in the bottom of the Crucible and another Crucible placed underneath it

filled with powdered Coal, in the upper Crucible is put a quantity of powdered oxide of Manganese kneaded up with Gum Ammoniac – the whole apparatus thus disposed is to be exposed to a violent heat for half an hour when a button of the Regulus of Manganese is found in the bottom of the lower Crucible – I have tried this method frequently but have never been able to succeed – tho' I have used a most intense heat –

Fourcroy and Scheele both say they have never been able to procure the Metal from the oxide, Bergman could not procure it, his experiments were made on the oxide of Manganese his Disciple Gahn did succeed in obtaining the Metal –

Sulphuric Acid acts on the oxide of Manganese, especially if heated and

disengages a large quantity of Oxigenous gas becomes oxigenated and destroys Colours —

Nitric Acid acts powerfully on it when heated, it becomes oxigenated much by this means — an escape of oxigene gas also is perceived in this case its action is assisted by Carbonacous matters as Sugar, Honey &c if there be added fixed air —

Marine Acid acts on it seizing its pure air and becomes oxigenated — (see oxigenated muriatic acid page vol 1) ———

Manganese refuses to amalgamate with Mercury, it unites with most other Metals with Sulphur and the Alkalis —

If One part of Manganese be fused with three parts of Potash the Product is Cameleon Mineral, so called because if thrown into Water it changes its colour very much blue green violet black red &c — all in the course of a few minutes — Oxide of Manganese if heated by a burning Lens in an

Atmosphere of Hydrogene Gas, is reduced and Water is formed ——

The Semimetal Manganese soon acquires oxigene from the Atmosphere and is reconverted to the state of an Oxide —

Lecture 38th —

The first metal we will treat of is —

Lead called by the Alchemists Saturn — Lead is the least brittle, least tenacious, least sonorous, least elastic, one of the most ponderous and fusible of the Metals the colour of Lead is a beautiful shining grey which is tarnished very soon by exposure to the Air ——

Lead is very easily oxided by exposure to the Air in a heat high or greater than the temperature at which it fuses — The oxides receive different names according to their colours the Yellow oxides are called Litharge, the dark yellow Litharge of Gold

and the lighter Litharge of Silver, very improper names are given to them by the Alchemists — If the flame be made to vibrate on the fused Metal the oxide assumes a beautiful red colour called Minium or Red Lead this is used as a pigment — the pure air may be taken from it by Sulphuric Acid, the gas is disengaged upon the addition of the Acid — No heat is sufficient to separate the air from Litharge — another mode of obtaining it from Red Lead is by heating it with a burning Lens in an Atmosphere of hydrogene gas, or in contact with any other inflammable — The Red Lead gains 12 per cent by its oxidation and 12 ℔ of pure Air may be obtained from 112 ℔ of Red Lead and exactly 100 ℔ of pure Lead remains to form the Red Lead the Metal must be fused in a shallow vessel & the flame

made to vibrate over its surface while in a state of fusion, takes an iron to stir it frequently, till it is all oxided, if the heat be urged above a certain point the Lead is vitrified and no red oxide obtained, this process is so troublesome that the Chemist never performs it — it is a distinct branch of business ——

Sulphuric Acid acts on Lead and if assisted by heat dissolves it, not else ——

Nitric Acid diluted also dissolves it but concentrated Nitric Acid has no action on the Metal — the Nitrate of Lead possesses a yellow colour and may be obtained in a crystalized form — if heated it burns with a yellow flame, if thrown on coals it decrepitates and leaves globules of Metal on the coals ——

The Muriatic Acid has a strong attraction to Lead, if in the state of an oxide

The Muriate of Lead decomposes all the other combinations of Lead, several methods may be pursued to form the Muriate of Lead, It is made by distilling Corrosive sublimate and red lead - by dissolving a Calx of Lead in Marine Acid - by fusing in a red heat a calx of Lead with common Salt, the Marine Acid and the Lead unite while the soda is set a liberty in this manner the Patent Yellow is made by Mr. Turner in England ——

The Acetic Acid unites with Lead and forms Sugar of Lead or Sacharum Saturni, a chrystalizable salt so called from its sweet taste, the Acetous Acid corrodes it forming Ceruse, the Sugar of Lead is made by digesting Litharge in vinegar & evaporating The Ceruse or white Lead is made by rolling thin plates of Lead about 4 or 5 inches wide and 2 feet long into spiral forms so that the distance between each roll may

be ¼ an inch - Earthen pots are procured of the diameter of the leaden spirals, and in which three points project at about ⅓ of the height, the pots are filled with vinegar to the height of the Lead and buried in stable under Horse dung, at the end of about a Month or six weeks they are taken out and the White Lead separated from the Lead this is an oxide and may be converted into Acetate by digesting in Vinegar, it contains however a small portion of Acetate — Cerure only differs from White Lead in containing Chalk which is mixed with it ——

Sugar of Lead is now very dear, it sells for One dollar per pound, and I am sure it might be made to advantage by exposing Lead to the expressed of apples after the Cider is expressed from them, vinegar is soon formed and would corrode the Lead forming Cerure and the Acetate is made by

digesting the Cerus in Vinegar —

Sugar of Lead may be decomposed by Ardent Spirit or Zinc – a piece of Zinc suspended in a vial containing sugar of Lead in Solution, is dissolved and the Lead deposited in the form of a beautiful Metalic moss, if much Zinc is used & the solution be suffered to stand a long time Inflammable Air is disengaged by the decomposition of the Water of the Solution —

Of the neutrals Salts Nitre is the principal one which acts on Lead, it deflagrates with it if thrown into an ignited Crucible when the Lead is oxided —

Of the Earths Clay acts most powerfully upon Lead, if Lead be heated strongly in a Crucible of Clay it vitrifies and forms a glass which runs through the Crucible Lead on account of its vitrifiable property is often used by the Glass Makers, for the

purpose of whitening and making their glass more fusible – hence we account for the globules of Lead which are often seen when a thermometer tube touches the Tallow of a Candle and is fused –

Lead is used by the Potters to give their vessels a coat of Glass – the vessels being dried are dipped into a paste made of a Calx of Lead and Water (red lead is often used). they are then heated intensely & become covered with a coat of glass – this Metallic glazing is soluble in Acids, hence we should be cautious about eating Pickles or Vinegar which has stood long in those earthen Vessels ——

Of the Inflammables Lead is chiefly acted on by Sulphur it changes its colour to a black – If letters be written with a solution of Sugar of Lead and the paper on which they are written be held

over Hepar Sulphuris the gas disengaged will colour the letters black. this phenomenon happens through 100 leaves of a book It does not act through the paper but through the interstices of the leaves as may be proven by sealing the edges of the leaves when no such effect will take place this fact not only shews us a handsome experiment but likewise teaches us to detect Lead in wines, a fraud this, which has often been practised by dealers in order to give their wines a sweet taste; the method of detecting it is to add orpiment or liver of Sulphur when the wine becomes turbid if it contains Lead —

Lead unites to most of the Metals but Iron - if Iron and Lead be fused no union ensues but they both flow separate

Water digested 2 or 3 Months on this Metal is decomposed & Hydrogene Gas escapes —

Lead is found in four different states in the Bowels of the Earth - 1st combined with oxigene - 2d with Sulphur - 3d With Sulphur and Arsenic - 4th Silver and Sulphur as in Pyrites which contain many other Metals - with Sulphur it forms the many varieties of Galena Plated Scaly &c &c - this is almost the only ore which is wrought to obtain the Lead - It is separated by heat and sometimes the black flux ———

Lecture 39th —

Tin — is a white Metal much resembling Silver very malleable & ductile called by the Alchemists Jupiter, Tin is not sonorous but when bended makes a crackling noise known by the name of the Cry of Tin, according to Margraaf this is owing to the Arsenic it contains -

Tin is fusible by a gentle heat, if the heat be urged a white powder is obtained

which is a true oxide of Tin, the Metal in the intermediate state between Solidity and Fluidity is very brittle and by the stroke of a Pestle or Hammer may be broken into a thousand peices — If fused and triturated in a hot mortar till it becomes solid is pulverized and affords the Pulvis Stanni, Tin cannot be vitrified by the most intense heat we are able to apply —

The Sulphuric Acid when heated and highly oxigenated oxides Tin, Sulphur is left behind by the decomposition of the Acid —

The concentrated Nitric Acid has no action on Tin, the instant that water is added solution takes place, & Ammoniac is produced by a decomposition of the Water whose Hydrogene unites to the Azote of the Nitric Acid and forms the volatile Alkali while the oxigene oxides the Metal — so that a double decomposition ensues, first

of the Water and 2.ds of the Acid — the Salt is a true Nitrate which detonates by itself in an ignited Crucible and is decomposed leaving a Calx behind, if burned it emits a thick whitish flame like that of Phosphorus —

The Muriatic Acid acts also upon Tin either heated or in the Cold, their union may be accomplished also by distilling Corrosive Sublimate and Tin, the product is originated or Butter of Tin, it emits vapours if exposed to the air whence it is called Fuming liquor of Libavius, who was the inventor of it — another method to obtain this fuming liquor is to amalgamate Tin with one fifth part of Mercury this mixture is distilled with an equal weight of Corrosive sublimate the fuming liquor comes over —

The Nitro Muriatic Acid dissolves Tin without effervescence —

The Acid of Tin is procured as the Arsenical by distilling Nitric Acid frequently from Tin — Vegetable Acids act on Tin — this cautions us not to drink Acid liquors which have stood long in tin vessels. tho' Tin is universally thought an innocent Metal, besides this Tin also contains a small portion of Arsenic — (to which it has a powerful attraction) and according to Geoffroy and Margraaf may be productive of ill consequences —

Alkaline Salts have no action on Tin

Of the Neutral, Nitre acts most powerfully on it — if heated they deflagrate most violently and the Tin is reduced to the state of Oxide —

The Earths have no remarkable action on Tin

Of the Inflammables Sulphur unites most readily with it, this

combination is known by the name of Aurum Musivum or Mosaic Gold- it is principally used to give a beautiful colour to bronze and also to increase the effects of the Electric apparatus, their union may be effected in the following manner An Amalgam is to be made of equal parts Mercury and Tin, for this purpose Mercury is heated in an Iron Mortar also hot, and melted Tin is poured in and stirred till cold so as to be pulverized to 16 ℥ of this Amalgam are to be added 4 ℥ of Sal Ammoniac and 6 ℥ of Sulphur and the whole put into a Matrass, it is now to be heated so as to raise a faint ignition at the bottom of the Matrass this heat must be continued for the space of 3 hours and is to be regulated by the sand bath, the Aurum Musivum sublimes and adheres to the Neck of the Matrass--

When treating of the Metals in general we observed that they fuse most readily when mixed one with another - We see a remarkable example of this in a mixture compound of 2 parts of Lead 3 of Tin and 5 of Bismuth, this alloy becomes liquid in the heat of boiling Water, this would be a good substitute for the sand and water bath, as it is more fixed than the Water, & fluid which the sand is not - Homberg says equal parts of each answer best but Sir Isaac Newton has proposed the proportions as just mentioned and they are certainly more fusible than equal parts -

An Amalgam compound of 2 parts Mercury 1 of Tin and 1 of Zinc answer better than Mosaic Gold for the purpose of encreasing the power of the Electric Machine - the Tin and Zinc are fused

and added to the hot Mercury and rubbed or agitated in a Wooden box chalked internally, after it cools it is to be powdered and mixed with Lard —

Tin unites readily with most of the Metals destroying their malleability it is added to copper to harden it, the smallest portion of fumes of Tin coming in contact with Gold or Silver effectually destroys their Malleability and Lustre —

Tin may be laminated and these leaves are used to Silver (as it is improperly called) Looking Glasses — It is laid on a table whose edges rise above its surface the leaves must be laid perfectly horizontal. Mercury is poured on them, the plate of Glass is shoved along the surface of the Mercury so as to prevent Air and impurities from getting between the Glass and Metal, heavy weights are laid on the

glass now and suffered to remain a few days when the Mirror is complete —

Tin plates as they are called are used for the purpose of making culinary utensils &c — they consist of Iron coated with Tin for this purpose Iron is laminated its surfaces cleaned and dipped vertically into fused Tin, the Tin adheres to the surfaces of the Iron and gives them a beautiful Silver like appearance, the solder used by Tinmen to join those plates together is composed of Lead and Tin, the parts to be united are placed in contact & sprinkled with Rosin, a red hot Iron is placed on some of the Solder it fuses a part of it and is applied to the rosin and Tin, it unites the pieces firmly together —

In speaking of Aurum Mussivum we only spoke of the usual method of making it, the Sal Ammoniac is not absolutely

necessary to the production of it. for it may be made without Sal ammoniac or Mercury Tin dissolved in Marine Acid and precipitated by Soda affords Aurum Murium by sublimation with Sulphur —

Of the different preparations of Tin the Pulvis Stanni is only used in Medicine as an Anthelmintic, some say it acts by the shape of its particles, some by the Arsenic it contains the dose is from ℈i to ʒi but Doc. Aston says it virtues are only to be obtained by using it in a much larger dose from ʒi to ℥iv per Diem in Molasses —

Tin is found in several different states in the bowels of the Earth - 1st combined with no impurities but existing in a perfectly native state - 2d combined with Sulphur - 3rd With Arsenic - 4th with Sulphur and Arsenic - 5th With Iron - 6th with Iron sulphur & Arsenic —

Lecture 40th –

We next pass to the consideration of that very useful Metal

Iron –

This Metal was distinguished by the Alchemists by the name of Mars. It is a grey Metal very ponderous, hard, sonorous, elastic maleable and ductile to a great degree, especially when heated. Iron attracts a red Colour and becomes oxided, if expond to the Air this is called rusting ——

The most astonishing property and that by which it is distinguished from every other Metalic substance is that of being attracted by the Magnet ——

Iron requires a most intense heat to fuse it. It is inflammable as may be proven by tipping a peice of Watch Spring or fine Iron Wire with Sulphur and setting it on fire, dipping it instantly into pure

Oxigenous Gas when the Iron will burn & be consumed - This is also proved by the fire which is produced in the Collision of a flint and steel, this Phenomenon is owing to the Combustion of small peices of Iron detached by the stroke —

The fusion of Iron is much assisted by a current of Air, if Iron be ignited to whiteness and blown on by a bellows the Iron will be fused in a short time —

A glassy oxide is formed on the surface of hot Iron known by the name of finery Cinder, Priestly gave it this Name —

Concentrated Sulphuric Acid acts on Iron if hot and is decomposed, Sulphur being formed, in the Cold it does not act - If this operation be performed in a retort and distilled to dryness, Sulphur and a white mass partly soluble in water are procured, the Sulphur proves the Acid to be decomposed -

If water be added to the Sulphuric Acid a great heat is produced and an escape of hydrogene gas follows owing to the decomposition of the Water whose pure Air oxides the Iron while the Inflammable Air escapes - the Sulphuric acid acts on the oxide and dissolves it forming Sulphate of Iron or Green Vitriol

The English Chemists tell us that the Sulphuric Acid disengages the Phlogistic principle from the Iron and reduces it to the state of oxide but this is false -

1st Because not any inflammable Air can be procured from the Sulphuric acid & Iron

2d Because Sulphuric Acid does not act on Iron in the Cold as the diluted does -

3d When Water is added that moment the discharge begins -

4th Unless it be added Sulphurous gas only is procured tho' heat is used ——

5 thly — Because we find the pure Air of the Water employed in oxidizing the Iron —

The Salt afforded by evaporation is called Copperas, Green Vitriol, or Sulphate of Iron, it contains ~~more than~~ near half its weight of Water and of course is liable to the watery fusion by heat, when this water is dissipated by heat the Salt assumes the form of a white Powder known by the name of calcined vitriol, if the heat be still further urged Colcothar of Vitriol is formed which is used as a pigment its Colour is a reddish yellow, Green vitriol is decomposed by Lime and the Alkalis, If Lime Water be added to a solution of Green vitriol an olive coloured precipitate falls down ——

Nitric Acid acts powerfully on Iron if diluted, the concentrated Acid has no action — Potash precipitates it from its solution in Nitric Acid, if more potash be added the Iron is redissolved & Alkaline Martial Tincture

of Steel is formed, Cast Iron is commonly used in the preparation of this substance, this contains 16 grains of Charcoal in the Ounce —

Muriatic Acid acts on Iron, the filings of Iron turn the colourless Marine Acid of a deep yellow Colour —

All the vegetable Acids exist in Iron, in this State Iron exists in the generality of Vegetables in form of Gallate, Citrate, Malate Acetate &c — those Plants which contain Iron yield a black powder when Alkalis are added to them —

The solution of a Calx of Iron in vegetable Acids is of a yellow colour and used to dye Linens &c — The Dyers often dissolve Iron in Strong Beer, to procure a yellow dye any other stain of Iron is whitened by the Muriatic Acid —

Iron united to a peculiar Acid called the Prussic constitutes the Prussian Blue — a singular accident gave rise to this discovery

Diesbach a Chemist of Berlin borrowed of Dippel a Brother Chemist some Alkali from which he had distilled an Animal Oil – Diesbach's object was to precipitate a solution of Cochineal, when to his great surprise as soon as the Alkali was added a beautiful blue colour was perceived he repeated the experiment several times and with similar results, the colour soon became an object of Commerce under the name of Prussian Blue —

The mode of making it now consists in adding 4 ℥ of Alkali to an equal quantity of dried Bullocks Blood the mixture is put into an ignited Crucible & covered till the whole mass be converted into a red hot coal, this is thrown into Water which dissolves much of it, the water is filtered and evaporated when it affords what is denominated Phlogisticated

Alkali; 2 ℥ of Copperas and 4 ℥ of Alum are to be dissolved in 1 ℔ of Water, the two fluids are added together, a blue precipitate falls down which is rendered more intensely blue by washing in Marine Acid This method is used in Chemical Laboratories, but when large quantities are to be prepared, clippings of Hides, Hoofs, Horns and other Animal offals are burned instead of Blood, they all yield Prussic Acid — The Bile is the only Animal substance which does not contain it — Some vegetables as the Sunflower Thyme &c — yield a blue precipitate with the Sulphate of Iron —

We are indebted to Macquer for many experiments on Prussian Blue — It is soluble both in Acids and Alkalis — De Fourcroy first obtained a peculiar Acid from Prussian Blue by heating it with Alkalis & Lime Water, he procured the Acid in combination

Se ma la prueba y

with the Lime or Potash which he used and denominated it the Prussic Acid—

The Prussiate of Lime & Potash are very excellent tests for Iron in Mineral Springs &c — they reproduce Prussian blue my method of procuring them is to digest 8 ounces of solution of Potash or Lime Water or 2 ℥ of Prussian blue in a moderate heat the Prussiates possess a yellow colour—

Lecture 41st—

Another very excellent test for Iron is the Gallic acid, this Acid exists in all astringent vegetables, Oak galls contain large quantities of it hence its name, the Oak bark Persimmon &c - contain much of it, It was formerly thought to constitute the principle of astringency, but this is not the case Alum is very astringent yet Alum contains no Gallic Acid — Sugar of Lead, white vitriol &c - the same yet they contain no Gallic

Acid, and on the other hand many vegetables contain gallic acid and possess no astringency, the Rhus Glabrum or Poison Vine is of this sort, Cullen and others have proposed to ascertain the astringency of certain Medicines by their property of turning Iron black (which is the way in which gallic acid detects Iron forming Ink with it) their results would be extremely fallacious, for the juice of the Persimmon for instance contains more gallic Acid than Galls, yet it does not strike a black colour with Iron, because it contains too much of the resinous principle, a slight change of colour is perceived but it precipitates and falls to the bottom, many other vegetables contain it which will not strike a black colour with Iron —

The combination of Gallic Acid and Iron forms common writing Ink and

the black dye - Common Ink is made by mixing powdered Oak Galls with calcined green vitriol adding Gum Arabic or Sugar (the former preferable) and dissolving the whole in water, the use of the Gum Arabic is to keep the other ingredients suspended properly and prevent their spontaneous precipitation, Mr Reboquer says that Logwood is of use in the formation of Ink, this I doubt — Mr Reboiquer's Receipt is as follows —

℞.	Nut galls	— ℥viij
	Logwood	— ℥iv
	Green vitriol	— ℥iv
	Gum Arabic	— ℥iij
	Loaf Sugar	— ℥j
	Blue vitriol	— ℥j —

dissolve in Distilled water ℔i — he used the blue vitriol to fix the Colour and under is permanent - the Sugar gives it a glossy shining appearance —

Of the Neutral Salts – Sal Ammoniac and Nitre act on Iron, if Iron filings and Nitre be thrown into an ignited Crucible they deflagrate violently the Iron is oxided and the residue is Welfers Saffron of Mars – If two parts of Sal Ammoniac and one of a calx of Iron be distilled together the product is Flowers Martiales, according to the French Chemists the flowers consist of Sal ammoniac coloured by an oxide of Iron, but they certainly contain two Salts Muriate of Iron and undecomposed Muriate of Ammoniac –

Of the Earths Calcareous acts by increasing the fusibility of Iron & is used as a flux for it

Of the Inflammables Sulphur acts very powerfully on Iron, if equal parts of Sulphur and Iron filings be made into a paste with Water and buried 4 or 5 feet under Ground, an Artificial Volcano

will be produced in a few hours - fire is thrown up, explosions heard, and all the Phenomena of volcanic eruptions, called from its inventor the Volcano of Lemery 50 or 100 Weight must be used in this experiment — Charcoal also unites with Iron Iron united to a certain quantity of Charcoal forms Steel, to make Steel Iron is hammered into cylindrical bars which are placed in furnaces and covered with powdered Charcoal, they are then exposed to an intense heat for a space of 10 or 12 hours, taken out while hot and plunged into cold water (this process is called Cementation) the Iron imbibes the Charcoal and is converted into Steel - Steel is much harder, more elastic and sonorous than Iron - it is so hard that Iron is cut by it, all edged Tools are made of Steel also Files &c — Steel differs in hardness

as it is wanted for different purposes — Steel frequently heated and cooled in close vessels loses its properties and becomes converted into Malleable Iron, this happens by the Combustion of the Coal — Steel is less easily acted on by Acids &c — than Iron Iron acquires weight by passing to the state of Steel ——

If vapour of Water be made to pass over Iron in an ignited state the Water is decomposed, its oxigene oxides the Iron while its Hydrogene escapes and may be received in Pnumato Chemic tub if the Iron be in a Gun barrel and a syphon adapted to one end of it — Alkohol may be decomposed in the same manner with Copper its hydrogene escapes and its Charcoal is left in the Copper tube made use of — Priestly calls this Charcoal of Copper, but it is common Charcoal

which preexisted in the Alkohol – he says that 800 ℥ measures of Inflammable Air may be procured by this means from 1 ℥ of Alkohol, but here he is certainly wrong I have performed the experiment but could not obtain near that quantity of hydrogene Gas

Various methods have been devised to prevent the spontaneous Oxidation or rusting of Iron vessels when exposed to the Air – Homberg directs to coat it with a mixture of hogs lard, linseed oil and black lead – the black lead mixed into a paste with Water answers equally well – Doctor Black says the blue colour which Iron acquires when moderately heated prevents all further oxidation of it in the Atmosphere however most Heating Iron hot and throwing it suddenly into Lime Water has the same effect by the deposition of calcareous Earth on the

surface of the Iron —

If a portion of Steel be placed in fused cast Iron the whole is converted into malleable Iron —

We come next to its Natural History —

Iron is very plentifully diffused through the bowels of the Earth. It exists in a thousand substances were we would least suspect it — every spot of the Globe contains more or less of this Metal — the various Earths owe their colours to Iron — It exists in many Mineral Waters — Some assert that large masses of native Iron have been found but others of equal respectability deny it and say say they are the remains of ancient mine works — A large mass of this kind has lately been discovered in Saxony — Iron is the colouring principle of a great number of stones as the Lapis Lazuli, Blood stone, Terra Pozzolana &c &c — this last mentioned substance

is a Volcanic product, remarkable for the curious property it possesses of becoming harder the more it is exposed to water hence it is used to build houses near the banks of Rivers - Bridges &c —

Ores of Iron are never wrought unless very rich of the Metal, that ore is not worth the trouble of assaying which is not strongly attracted by the Magnet — Martial Pyrites is a combination of Iron and Sulphur, this ore is often wrought to procure the Sulphur, which is done by mere heat and the Iron is obtained in a state of purity — These Pyrites are various in form colour &c - The radiated Pyrites appears to be compound of Crystals or Stria running from a center to the circumference, it is of a dirty brown colour, so hard as to give fire with the steel and hence called Pyrites from Πυρ Fire —

Then Pyrites are often converted into green Vitriol by exposure to the Air a long time this takes place by the Sulphur being converted into Sulphuric Acid by attracting the pure Air of the Atmosphere — this Acid dissolves the Iron and forms green Vitriol — Large quantities of this substance were made in this manner during our Revolutionary War by two Dutch Boys, they lived at Lancaster where they could procure Pyrites — they exposed these Pyrites to the Sun for a long time till the Acid was formed, they then heated them and threw them into Water which was evaporated & Chrystalized —

Lecture 42nd —

The Iron Ores abound in Germany Spain and America, simple fusion is all that necessary to purify Iron, the Iron thus procured is cast into bars of a

considerable thickness & called Pig Iron to under this porous, brittle Iron malleable it must be forged i.e. heated and hammered out by very heavy hammers worked by water & contrived for the purpose

A very cheap flux for Iron Ores is Lime

Plumbago is a combination of Iron & Charcoal in greater proportion than in Steel - It is called Black lead or Carbine of Iron, it leaves a black trace on paper and soils the Fingers, hence is used to make Pencils, this done by sawing it into thin plates or leaves and fitting those plates to a Groove in a Wooden Cylinder, the leaf is cut off so as to fill up the Groove - the Jews make an inferior sort of Black lead pencils, by kneading the Black lead with Sulphur or Mucilage the first may be detected by holding the Pencil in a Candle when the Sulphur will

burn - the Mucilage by solution in Water - This Plumbago is of use in making Crucibles, Furnaces &c - a very good lute for coating vessels may be made by mixing it with 1 part of Cows dung and 3 of Charcoal - the Glass of the vessels will melt before the lute changes its form ——

The working of Iron ores has been long known - Agricola who wrote in the 16th Century describes the process very accurately ——

The only preparation of Iron used in Medicine is the rust of Iron a brown oxide this contains a portion of fixed Air but is not as Fourcroy has asserted a Carbonate of Iron - it may be detected in the urine of such as use it, by means of the common tests for Iron - that rust of Iron is best for Medical uses which has been exposed for

a long time to the Air, as it absorbs more fixed Air, but it is so far from containing as much Carbonic Acid as a Carbonate that 1℥ of it only contains 4℥ measures of fixed Air, whereas 1℥ of the precipitate of Iron by Carbonate of Potash yields 34℥ measures perhaps the saturated Carbonate would be preferable for Medical purposes —

I have lately seen a new publication of Dor. Priestly's entitled "The composition of Water refuted and the Phlogistic Theory established, much as the Title promises this point is far from being established —

In this work Dr. P. says no oxygen can be procured from the Iron filings or Iron Wire made use of in the decomposition of Water, there are finery Cinder, this readily part, but if it be heated in hydrogene gas Water is formed, a certain proof that the Oxygene of the finery cinder did unite

to the Hydrogene and form this Water
Again if the Water is not decompound
how happens it that the Iron gains 33 per
cent by the process - Dr. P. says by the
union of Water, some water certainly does
exist in finery Cinder contrary to what
the French Chemists say, they say it is
a pure oxide, Priestly that it is a compound
of Water and Iron, both are wrong, for
Water and Oxigene both exist in the finery
Cinder, to prove that it contains Water
it is sufficiently to heat it intensely in
contact with Charcoal, when Carbonated
Hydrogene will be procured - Priestly
says he obtained 156 ⅔ Measures of this
Hydro Carbonate from 1 ⅔ of the finery
Cinder - I repeated the experiment
but after heating the finery Cinder for
six hours very intensely, I procured but
142 ⅔ measures from 1 ⅔ of it and an

equal weight of Charcoal in powder This could only arise from the decomposition of Water — Priestly's principal objection to its containing oxigene is its being attracted by the Magnet after the Hydrogene escapes ——

Lecture 43rd —

Copper — This Metal was called by the Alchemists Venus on account of the facility with which it unites with the other Metals, It is a reddish brown Metal, very maliable and ductile, affords an unpleasant smell by friction, very elastic, sonorous &c &c — The Germans flatten it into plates simila to leaves of Gold or Silver, they expose these leaves to the vapours of Zinc, which gives them a polish and colour very similar to that of Gold leaf, it is used for an inferior

kind of Gilding - a proof of the great malleability of Copper - Copper requires an intense heat for its fusion when fused it is of a green colour nearly like Gold -

The Sulphuric Acid highly concentrated has no action on Copper the moment Water is added solution takes place and a blue Salt is formed by chrystalization, known by the name of Cupreous, blue or Roman Vitriol, called in the New Nomenclature Sulphate of Copper - It has a caustic astringent taste, it is used as an Escharotic and Emetic - Lime Magnesia and the Alkalis decompose the Sulphate of Copper, if Potash be used vitriolated Tartar is obtained, if Soda Glaubers Salt, if Ammonia a blue precipitate is received which is redissolved by more of the Alkali and by evaporation affords the Cupreum Ammoniacum -

The Nitric Acid has no action on Copper unless diluted, it then dissolves with

an escape of Nitrous Gas - Ammoniac is some times produced in this experiment, this happens by the decomposition of the Water & Acid the oxigene of both unite to the Metal while the Hydrogene of the Water & Azote of the Acid unite and form the Ammoniac after this the remainder of the Acid which is not decomposed dissolves the oxided Metal the liquor by evaporation affords a green Salt which detonates and is decomposed on hot coals, it is decomposed by most of the Metals, the Nitrate wrapped up in Tinfoil and moistened with water is decomposed in a short time with a deringagement of heat and Light ——

The Marine Acid when concentrated and boiling acts on Copper, the Muriate of Copper is a greenish Salt somewhat inclining to a brown by evaporating the Muriatic solution chrystals of it are obtained

The vegetable Acids act on the oxides of Copper and dissolve them, Vinegar is

commonly made use of for this purpose
Acetous Acid may be boiled in Copper ves-
sels and if poured out instantly it holds
no Copper in solution but if it remain
a long time in the vessel it contracts
a disagreable and unwholesome taste —
Verdigrise is made at Mountpelier in France
by fermentating the refuse of Grapes after
the Wine is expressed from them, Copper
in plates is exposed to these Grapes while
in the act of fermentation, a green substance
forms on the surface of the Copper and is
scraped off in the same manner as Cerus
from Lead, I am convinced Verdigrise
might be made in this Country by fer-
menting the refuse of Apples after the
Cyder is expressed from them — If vinegar
be boiled on this Cerus of Copper it dissolves
it and forms a chrystalizable Salt, these
chrystals are what the Painters call

distilled Verdigris, this name is very improper by distillation the verdigrise affords a very highly concentrated Vinegar equal in strength to the Mineral Acids this dejected on the Salts of Tartar forms the celebrated four Thieves Vinegar so much extolled in the Yellow Fever of 1793 - It is an acidulous Acetate of Potash, Potash supersaturated with the Acetic Acid, it is a very pungent acid substance, It acts upon Zinc like the diluted Sulphuric Acid with an escape of hydrogen gas Lime and the Alkalis act on Copper and extract a blue colour from it ——

Copper in fine leaves or powder is inflamed in the oxigenated Muriatic Gas ——

Chalk added to the Nitric solution of Copper from which all the Silver has been precipitated forms Verditer much esteemed by Painters ——

Nitre deflagrates with Copper (if heated) & is deprived of its Water of Chrystalization the Copper is oxided —

Muriate of Ammonia also acts on Copper, if sublimed with Copper in the proportion of ℥viij of Sal Ammoniac and ℥j of Copper the Ens Veneris is the result, it consists of muriate of Copper and undecomposed Muriate of Ammonia, the Copper for this purpose must be in fine powder and very hot —

Aqua Saphirina is made by mixing ℥viij of Lime Water ℥ij Sal ammoniac and 4 grains of Verdigrise together, suffering them to stand 24 hours and filtering the liquor — Or by digesting Sal Ammoniac and Lime Water in a Copper vessel several days

Turpentine digested on Copper extracts a green colour from it —

Copper precipitates Mercury from

its solution in Nitric Acid, the Mercury is deposited on the Copper in a wired form

Copper is precipitated from its solution by suspending an Iron key or other polished instrument in the solution the Copper is deposited and forms a coat on the surface. If a quantity of Iron filings be placed in a solution of Blue Vitriol the Copper is precipitated from its solution in form of a red powder and the Iron is dissolved in its place, if the Water remains long on the Iron filings a decomposition takes place and hydrogen gas is disengaged, hence we explain the fact that certain Rivers in Germany convert (as the vulgar say) Iron into Copper. the fact is the River washes over some beds of Cupreous Pyrites and dissolves a portion of the Copper which is deposited on Iron Instruments placed in those Rivers —

Copper unites with almost all of the Metals, with Zinc it forms brass, Pinch beck and other alloys resembling Gold - Ammi is sometimes mixed with Copper to make it white and hard, we should be cautious how we use vessels made of this kind of alloy - Bell Metal is made of Tin Copper and Zinc - Tin is frequently used to coat the internal surface of Vessels in order to prevent the Copper from being dissolved, the Tin however is not pure but is a kind of Spunbum or Bell Metal -

Lecture 44th -

As to its Natural History it exists in almost every part of the World - it abounds in Pennsylvania, Hungary Germany Sweden &c - also in England 16 of the 48 Counties in England contain Mines of Copper - Copper is instantly

detected in an Ore by solution in Nitric Acid and the addition of Volatile Alkali which forms Cuprum Ammoniacum with the Copper and is known by the blue colour

Copper Ores may be divided into three kinds 1st – Combined with Oxigene – 2nd combined with Earth, Iron or both – the 3d comprehends a vast variety of cupreous ores – all combination with Arsenic and Sulphur, of course the various pyrites which contain Copper – the pyrites of Copper no worth working are called Marcasite, they abound with Sulphur, the second species are not commonly wrought the Ores are wrought in the same manner as the Metals in general –

Copper is procured in Germany from certain Springs which hold it in solution, it has lately been obtained in the same manner in Ireland – an Irishman

who had been working near some Copper Mines left his Spade by accident in a Spring near the Mine, in calling for it some time afterwards near 3 Weeks he found as he thought changed into Copper, a very thick deposition of Copper was evidently all over the Iron — the owner took the hint and made holes in the Earth near the Spring, so that the Water might flow into them, the mud became impregnated with the Copper and 100 Tons of it yielded from 84 to 94 of Copper this Copper is much purer than that wrought from the Ore, and the Springs are now more valuable than Mines themselves —

The Ores are known by their brassy colour and solution in Acid & adding the volatile Alkali

Of the preparations of Copper, Cupreum Ammoniacum, Verdigris, Ens Veneris &

Blue Vitriol are principally used the last is a powerful Caustic and emetic, it has been lately used with success in Epilepsy and Hysteria the dose is from 1/4 a grain to 1/2 a grain to be increased to what the Stomach will bear ——

We now pass to consider the third Class of Metals viz. the Perfect or Noble Silver, Gold and Platina —— They are unchangable by the combined action of heat and air they possess Malleability and Ductility in an eminent degree, one grain of Silver may be extended into a Wire 3 Yds. long and this wire flattened to the breadth of two inches, the wonderful extensibility of Gold & Silver is seen in Gold & Silver Lace this contains but 1/48 part Gold in its composition ——
Silver has been extended into a Leaf

the 134000 part of an inch in thickness, and Gold to the 100000000 part of an inch. this is almost incredible but really the fact, Mr. Lewis has computed that one grain of Gold may be extended into 400 square inches —

We said they are not changed by heat and Air — Mr. Boyle exposed a Lump of each to a most intense heat in a Furnace for the space of three Months and they suffered very little if any alteration — they differ from other Metals in not being acted upon by the Neutral Salts as Nitre — Lead does not unite to Silver but is used to scorify it, 100 lbs of Silver loses one ounce by scorification with Lead, the process is also called Cupellation, it is performed by exposing to heat Silver and Lead in a kind of Crucible, made of burned bones, or porous Clay

called a Cuppel, the Lead unites with all the impurities of the Silver and being vitrified sinks with them into the substance of the Cuppel, Copper itself is separated thus —

Then are the properties of them in general we shall next consider each of them separately — and first of

Silver —

You are all well acquainted with the general properties of this Metal, its colour, brilliancy, weight &c &c — its malleability & ductility have just been spoken of —

Fusion is the only change which heat produces on Silver and this requires that the heat should be very intense, a curious phenomenon is observable in the congelation of Silver, it is called the Vegetation of Silver, it is a sort of

Chrystalization which takes place and causes the Silver to shoot out into small branches and is owing to the contraction of the superior surface which cools first —

Silver is tarnished by the fumes of putrid substances & Sulphurated hydrogen gas

If Sulphuric Acid boiling and concentrated be added to Silver it dissolves a small quantity previously oxiding it — the Salt obtained is a true Sulphate of Silver, it fuses on hot coals, is decomposed by the fixed Alkalis, Lime Water, Iron Copper, Zinc, and Mercury — these substances act by uniting to the acid and heat is afterwards sufficient to revivify the oxide of Silver —

Nitric Acid has no action on Silver unless diluted, the Acid might be carried 100 Miles in a Silver vessel & not dissolve it provided no Water were present, but

the moment water is added the Metal is dissolved with an escape of Nitrous Gas the Nitric solution of Silver is commonly of a greenish blue colour owing to the Copper which the Silver usually is alloyed with, if Gold exists in it, this known by a black precipitate which falls down this is often seen in a solution of Lunar Caustic, if the Nitric solution of Silver be evaporated Chrystals of the Nitrate may be obtained, these chrystals when fused and cast into cylindrical moulds forms the Lunar Caustic – the diluted Nitric solution is bitter to the taste and of a black colour in consequence of exposure to Solar Light, for this colour is not seen in a fresh solution, the chrystal are likewise black after exposure to Light – the Nitrate of Silver is used to colour precious Stones, as Diamonds

Rubies, Garnets, Jasper, &c - The Phlogistian Chemists after Stahl say that the Silver is wired in the Light and acquires its Phlogiston, this is not the case if it were Lunar Caustic could be kept only in the dark - Lunar Caustic is a diliquescent Salt, deflagrates in the fire and is decomposed, it is decomposed by Lime the Alkalis, and most Metals, as Mercury, Copper, Iron, Tin, Zinc &c —

If Mercury be poured into a Nitric solution of Silver Arbor Diana is formed it is a kind of vegetation or chrystalization which is called Philosophical Tree or Arbor Diana - Lemery first described the process of making the Tree, he directs to add to ℥j of Silver dissolved in Aqua Fortis 20℥ of distilled Water & 2℥ of Mercury Homberg's method is to Amalgamate 4 parts of Silver and 2 of Mercury, directed

Nitric Acid is to be added to the Amalgam and is suffered to stand for 2 days and precipitated by adding more of the Amalgam — Mr. Baume says 6 ℥ of Silver in 4 ℥ Aq. Fortis and 5 ℥ Water add to this 6 ℥ of Mercury amalgamated with 2 drachms of Silver — he thinks the chrystalization is owing to the Mercury of the Amalgam uniting to the surplus of Silver in the Solution — the Mercury may be driven of by heat & the Silver revived —

Berthollet has lately discovered the most astonishing property of Silver we are acquainted with, the following is the process - Take very pure Silver of Cupelation dissolve it in Nitric Acid precipitate the solution by Lime Water decant the fluid and expose the precipitate to the Air for 3 days mix this dry oxide with caustic volatile Alkali

decant the fluid and dry the black powder which remains in the open Air, this is the Fulminating Silver, Fulminating powder, Gunpowder, the very Thunder of Heaven itself is innocent when compared to this terrible product — Heat is necessary for the explosion of all other combustions, but the contact of a drop of Rain a flake of Snow, in short of any substance whatever is sufficient for the explosion of it — Berthollet handed some of it to Chaptal in a glass vessel, Chaptal took hold of it, it exploded, broke the vessel into a thousand pieces tho' very fortunately neither of the Chemists were injured, 1 grain is the largest quantity which can be safely used in the experiment — Doc. Higgins had fifty pieces driven into his Hand, by the explosion of some ~~which~~ he was preparing

The Fulminating powder consists of Ammonia and an oxide of Silver, the French

Chemists say the oxigen of the oxide is disengaged and meet with the hydrogene of the Alkali and so explodes, this I doubt very much and think the explosion cannot be readily explained ——

Lecture 45th —

If Copper be suspended in a Nitric solution of Silver, the Silver is deposited on the Copper in a revived State ——

Marine Acid has no action on Silver unless in the state of oxigenated Muriatic, or unless it be digested on it for a very long time or unless it be added to a Nitric solution in either case it unites to the Silver, the Salt is called Luna Cornea, it has lately been substituted for Lunar Caustic and I am told with advantage ——

Berthollet says that 16 ounces of boiling Water dissolve 3 or 4 grains of this Muriate It is decomposed by Alkalis — If exposed to a strong heat the Acid is driven off and the

Silver unived - If it be exposed to light on a clear day it suffers its pure Air to escape and loses its white colour being turned brown the Muriate of Silver may be fused by heat and still retains its transparency, this circumstance gave Thunbell an Idea that malleable Glass might be made, for this Muriate runs into a Glassy substance, He declares that he discovered a Malleable Glass but it is now generally thought that it was nothing more than Luna Cornea - Silver is found in usual different states combined with Lead - Arsenic - Sulphur & Arsenic - Tin - Mercury - Cobalt - Bismuth - Nickle - and Regulus of Antimony - It seldom repays the trouble of extraction from Lead - 60 Ounces of Silver is as much as is usually found in a Ton of Lead - Mr. Simms has lately prescribed Lunar Caustic and Luna Cornea in Epilepsy the dose is 1/10 of a Grain ——

Gold –

This is the most ponderous of the Metals excepting Platina, Gold is fusible in a heat approaching to that of whiteness Its elasticity is very great – Heat and Air have no action upon Gold excepting that of uniting it fluid its colour is thus Green and appears very bright owing to the evaporation of Mercury and other impurities An Amalgam of Mercury & Gold may by heat be somewhat oxided, Tin also increases the fusibility and oxidability of Gold in a state of fusion contracts below and is convex on the surface, It is brittle when in an intermediate state between Solidity and Fluidity —

Gold may be made of different Colours according to its various Mixtures with Silver and other Metals —

The Acids have little or no action on Gold when pure, excepting Aqua Regia

and oxigenated Muriatic Acid, hence the use of the Touchstone as it is called - this is a Polished piece of black basaltes or Wedgewood Ware - such as Teapots are made of; the Gold is rubbed on this Stone so as to leave a slight mark on it, Aqua Fortis is rubbed on this & in proportion to the rapidity of the action of the Acid we judge of the purity of the Gold - if all the Gold remains on the stone no alloy exists in it, but all the impurities are dissolved by the Acid ——

Nitro Muriatic Acid is the solvent most commonly employed for the solution of Gold, this liquor is made in several ways, one is to mix 3 parts of Nitric with one of Muriatic Acid, another to dissolve common Salt and Muriate of Ammoniac in Nitric Acid and distilling them, another to distill Nitre and Marine Acid - another to to distill Alum Nitre and common Salt - in this latter the Sulphuric Acid of the Alum

does not rise with the Aqua Regia but unites to the Alkalis of the common Salt & Nitre while their respective Acids unite and rise into the receiver in form of aqua regia — also by dissolving common Salt in Nitric Acid and distilling — this mode is commonly used. the proportions are 1 of common Salt and 4 of Nitric Acid — Thunshel's method of dissolving Gold is to take Gold leaf a mixture consisting of three times as much Nitric Acid as common Salt is added till an equal weight is added to the Gold, the Gold now fumes is turned to a beautiful colour (yellow) and is dissolved, this liquor always turns the Nails, Cuticle and other Animal Matter to a purple colour —

Brandt a Chemist boiled Silver & Gold in Nitric Acid a small quantity of the Gold was dissolved, we have however very few experiments to prove the action of the Nitric Acid on Gold — The solution in Aqua Regia is used to colour stones, porcelain and

other Earthen ornaments, Marble may be co-
loured of several colours by using different
proportions of the two Acids in the solution
the Alkalis precipitate Gold from its solu-
tion of a Yellow colour, the volatile Alka-
li precipitates it forming Fulminating Gold
when properly dried this substance detonates
by a very moderate heat, the gas disengaged
in the explosion of fulminating Gold and
collected under the Pneumato chemical appa-
ratus consists of Nitrogene and a small quan-
tity of Water — If heated gently in a copper
tube inverted under Water by a Syphon Al-
kaline gas is obtained and the Gold is de-
prived of its fulminating property, this is
an experiment of Mr. Berthollet — By
triturating Fulminating Gold with inflam-
able substances as oils it is deprived of its
fulminating property — these experiments
prove that this preparation consists of an
oxide of Gold and Ammonia — The
French Chemists, say that the oxigene is

disengaged from the oxide and hydrogene from the Alkali then meeting together explode - hence the reason why Oily & inflamable matter deprive it of its fulminating property, by uniting to the oxigene some Authors say the precipitate should be washed before it is used, others that washing deprives it of its fulminating property, at any rate it can I should suppose be of little use - -

Lecture 46th.

Inflammable substances precipitate Gold from its solution without the assistance of Heat —

We before said that oxigenated Muriatic Acid dissolves Gold, Ether precipitates it from this solution and undissolves, as it also does the Nitro Muriatic solution which I believe forms a Muriate with the Gold, Spirit of Wine precipitates the solution but does not undissolve it —

Most of the Metals and Metalic substances decompose the solution of Gold Green Vitriol is frequently used for this purpose – Mr. Lewis first observed this fact, the precipitate is of a beautiful yellow colour and much used in Gilding Silver, Bismuth, Copper, Iron, Mercury Zinc and Tin all produce a decomposition of the Solution of Gold, if Mercury be used the Nitric Acid unites to it, and the Muriatic remains united to the Gold –

If to a solution of Gold in Aqua Regia we add a Nitro Muriatic solution of Tin a most beautiful purple precipitate falls down called from its first discoverer Purple Precipitate of Cassius – this does not acquire its purple colour instantly – it is much used to paint porcelain Thunkel says that one grain coloured very beautifully 1280 grains of glass and that it coloured very perceptibly 1920 –

The Tin is oxided in this experiment and probably the Gold and Tin both exist in the precipitate —

Gold is used to detect Mercury with which it forms a whitish compound

Gold unites with most of the Metals they all render it brittle, one grain of Tin whether in form of fumes or any how else renders 1000 of Gold brittle — Nickel Bismuth Mercury and Antimony all have the same effect — Silver and Copper are the only Metals which can be alloyed with Gold without producing this effect —

Of the inflammable substances Sulphur acts on Gold by carrying off its impurities, hence it is used in purifying Gold — The usual method of separating Metals from Gold is to fuse them in a Crucible with Sulphur and Antimony the Sulphur unites to the other Metals and the Antimony and Gold fall to the bottom of the Crucible —

Hepar Sulphuris dissolves Gold very completely, it is made by fusing equal parts of Sulphur and potash – Stahl supposes this to have been the way in which Moses dissolved the Golden Calf – the solution is of a very nauseous taste and purges violently probably these circumstances rendered it a proper punishment for the Idolatry of the Israelites – Sulphur deprives fulminating Gold of its property of detonating and Zinc prevents it from acting in this way –

The Amalgam of Mercury & Gold is much used in Gilding Metals as Brass Copper &c – The Metals being clean are put into a solution of Mercury in the Nitric Acid, then the Amalgam is poured over them and the Mercury evaporated by heat and the Gold burnished ——

Pure Gold which contains no alloy is said to be gold of 24 Carats fine, i.e. when one ounce of it contains 24 Denpiles

of pure Gold, if it contains one sample of Silver in the ounce it is said to be 23 Carats fine —

There are 4 Methods now in use of purifying Gold - 1 Cementation - 2° Cuppellation - 3 By means of Crude Antimony and 4th By solution in Aqua Fortis —

1st - In the first method Silver & Gold are put into a Crucible with some Green Vitriol and Nitre or common Salt (which act on all Metals but the Perfect) they are next exposed to an intense heat and all the Metals but Gold Silver & Platina are converted into Scoria - this method is objectionable because the acid of the Nitre has some action on the Gold and Silver —

2nd - By exposing to heat with Sulphure of Antimony - this the Alchemists say is a good method, the heat must be very intense, the Gold and Antimony unite, while the base Metals are vorified and float

on the surface, the Silver is not seperated by this method that must be done by other means for Sulphur does not act on it—

3rd — Cuppellation, this consists in fusing in a Crucible of porous clay or burned bones a mixture compound of Gold and Silver with 8, 10, or 16 times their weight of Lead, the Lead unites to all the Metals but Silver which is seperated either by dissolving it in Aqua Fortis or by dissolving the Gold in Aqua Regia, if the Silver be not used the Lead and Gold unite — more especially if Copper be used. the proportion of Gold to Silver is as 1 to 3 hence the operation is called quartation, the Gold and being but a quarter of the Mass——

4th By Aqua Fortis, this may be used to seperate every metal from Gold, which is soluble in Nitric Acid and to this there are but few exception — Nitro Muriatic is

also used to separate the Gold ——

The method used in our Mint to purify the Gold is as follows

The first process is to determine the purity of the Gold by solution in aqua Fortis. it is next Cappelled the Silver & Gold unite by this process and all the base metals are sacrificed - it is next boiled in aqua Fortis to dissolve all the Silver. the Gold is now perfectly pure and of 24 Carats, ~~to be~~ alloyed with its quantum sufficit of Silver and Coined —

Gold is by no means so scarce as we suppose. it exists in large quantities in every part of the Globe but in so diffused a state as not to repay the trouble of extracting it. from the experiments of Becher, Henckel, Sage, Margraaf &c - it appears to exist in Vegetables. Much exists in the west India Islands but the Ores are too poor to be worought, but is occasionally procured from those

Ores which are wrought to obtain the Silver
In Africa it is found in sand along the
Banks of Rivers - the banks of certain Ri-
vers in France contain it according to Mr. Beau-
mer and it is extracted by some of the Peasants
to advantage — Scotland the poorest Coun-
try in the World contains Gold - it was
formerly coined there, but Gold was much
more valuable then than it now is — Indeed
few sands exist which do not contain some
Gold, the black sands most — The Ores
of Gold are wrought by one of the four methods
first mentioned, Potash is sometimes used
in the process - That sand is said to be
worth working which yields 24 grains of
Gold per 100 lbs - Some sands are so very
rich as to yield 53 grains in every 5 lbs -
Electriation may be used to separate it, the
method used by the Spaniards is Amalgama-
tion with Mercury, which is afterwards

separated by heat. Large quantities of Quicksilver are sent from Hungary to Spain for this purpose ——

Platina –

Platina was first discovered in Peru in 1749 – the Spaniards called it Platina from its resemblance to Silver and as it was found in small grains they called it Little Silver Plata being Silver Platina little Silver – Dr. Browning first described Platina to the Royal Society in 1750 – he says it is procured in the Spanish West Indies and that the Natives use it for various utensils but he is Mistaken for being almost infusible they could not cast it into any shape – Marquer Lewis Margraaf have all successively experimented upon Platina and communicated their results to the Public –

The most usual form of it is that of flattened grains, it is frequently found in

Mines of Copper and Mercury and very much resembles Silver in Colour, Its gravity is very great exceeding that of any other Metal - it is very difficult of fusion - Is attracted slightly by the Magnet - The mode of fusing is by a very large Lens or else by a flame urged by the blow pipe and pure Air the metal being placed upon Charcoal, it is fused in a short time in the focus of Mr. Tudaines burning Lens which is 4 feet in diameter and contains 40 pints of Alkohol - Platina is malleable and ductile more fixed than Gold or Silver - Mr. Richards method of fusing Platina consists of mixing equal parts of platina, oxide of Arsenic and Cream of Tartar. and exposing them to a violent heat in a Crucible after it is fused the heat must still be more intense and a muffle must be used to separate the Arsenic - according to Baume, Lead, Arsenic, Bismuth &-

Antimony unite to Platina by fusion —

Of the neutral Salts Nitre acts most powerfully upon Platina, the Earths, Alkalis &c have no action on it, Sulphuric Acid tarnishes its colour, Marine or Nitric have no action upon it except to restore its brightness — Aqua Regia formed of equal parts Nitric and Marine Acids dissolve it, the Alkalis precipitate it from its solution — The Salt procured by evaporating the Nitro Muriatic solution is an oxigenated muriate of Platina this Salt is totally soluble in Water —

Ammonia added to a solution of Platina and Gold in Aq. Regia precipitates the Platina in form of a brick dust coloured powder ——

We have little to say concerning Tungsten, Molybdena Wolfram &c — and for the three last discovered semimetals — Sylvanite, Tetanite and Uranite, Refer to Thomsons Mineralogy Volume 2nd ——

Lecture 47th—

Charcoal is called in the New Nomenclature Carbone, it is the residue which remains after the volatile parts of vegetables are dissipated by heat, It is a simple or undecomposable body— Dr. Austin apart from some experiments that charcoal is composed of Hydrogene & Azote he has been followed by many Chemists of the present Day —

Charcoal exposed to heat in close vessels suffers no change, but if heated in the open air unites with oxigene and forms fixed air the combustion of Charcoal produces a very intense heat —

You are all well acquainted with its external appearance viz- that it is a light spongy black brittle sonorous substance, in these properties it varies as it is procured from different kinds of Woods and different parts of vegetables— Wood affords most— Gums next—

Resins next and Oils last of all — The Charcoal procured from Resins and Oils is called Lamp-black, the greatest possible heat in furnaces is produced by a mixture of Coke and Charcoal this Coke is a fossil coal charred —

Sulphuric Acid is decomposed on Charcoal (in powder) its oxigene unites to the charcoal and forms Carbonic Acid while the Sulphur is deposited

Nitric Acid is also decomposed on Charcoal in powder or Lampblack, Macquer, De Fourcroy — Priestley — Proust &c — have all performed this experiment, Fourcroy says he took some coal prepared by burning the Carthamus, having dried it perfectly and adding highly dephlogisticated Nitric Acid the detonation succeeded instantly — to produce this effect the Acid must be very highly concentrated and the Coal perfectly dry, Coal made in the evening does not answer for this experiment the next morning as it attracts the moisture from the Atmosphere — another

caution necessary is to let the acid trickle down the sides of the vessel – In the experiment the oxigene of the Nitric acid is decomposed its heat and light set a liberty

M. De Fourcroy performed the experiment in a retort in this case a stream of fire four inches long issued out of the retorts beak he used ℥i of powdered Charcoal and an equal quantity of the acid – the appearance resembled a rocket, a few drops of the acid I think answers better than an equal weight Dr. Priestly has communicated an account of the gases disengaged in this experiment to the Philosophical Society, he says that Phlogisticated air only is disengaged but he is mistaken or else did not use fuming acid and Coal, his Coal must have contained Water to yield him this result and it does not always happen if Water is used – Many methods for accounting for the disengagement of heat

and Light have been proposed, some have contented themselves with saying it is owing to a change of capacity by which the new product cannot contain the heat in a latent form, it appears unexplicable anyhow else — Instances have occurred of Charcoal inflaming by means of oil - a Frigate in the Port of Cronstadt just ready for Sea took fire by this means (in Nicholsons Chemical Journal in which the fact is related) This Terrible accident induced Mr. Georgius a Chemist of Petersburgh to make some experiments on this subject, the results of which he communicated to the academy of Petersburgh, he took 3 ℔ of Lampblack and moistened it with Hempseed Oil he suffered it to stand wrapped up in Linen cloths for 16 hours when a strong smell was perceived, soon after which it inflamed - he next took 30 ℔ of Coal and 3 of hempseed Oil in 3 hours it was

Gaseous oxide of Carbon is obtained

1st By exposing Water & charcoal to heat, we obtain carbonic acid gas, carbonated inflammable air, & oxid of carbone. In this experiment the water is decomposed part of its oxigene unites to the coal & forms carbonic acid, the hydrogene dissolves a portion of the coals & comes over in the form of carbonated hydrogene gas, while another part of the oxigene of the water unites to the coal & forms oxide of Carbon.

2nd By putting Chalk & Iron in a gun barrel & exposing them to heat, the carbonic acid is disengaged from the Chalk and as it passes over the Iron it is deprived of part of its oxigene & comes over in the form of oxide of Carbon

3 By exposing finery cinder & charcoal to heat the oxigene is driven off the finery cinder & unites to the Carbon, forming carbonic acid & oxide of Carbon.

4 By exposing some of the metallic calcs & charcoal to heat, as Flor. Zinc &c.

heated to near 99° Farenheit, in another hour its temperature was much increased and in another it inflamed —

Mr. Volta has found that Charcoal (tho a non conductor of heat) is a very excellent conductor of Electricity, he says he does not class it with the meanest conductors as Bismuth Lead &c — nor the moderately good as Copper Brass &c — but with the most powerful as Silver, Gold, Tin Platina and Mercury, he adds that the strongest shock of Animal Electricity may be felt by Charcoal & Silver or Charcoal and Tin —

Water is decomposed by ignited Charcoal either by passing the water in form of steam over the ignited Coal or by plunging the coal into Water, the oxigene of the Water unites to the Coal and forms Carbonic Acid while the hydrogene escapes and forms with the fixed Air Carbonated Hydrogene Gas, this is proved by agitating the Gas in the Eudiometer tube filled with

The Properties of the Gaseous oxide of Carbon are 1st - It is lighter than atmospheric air

2 It is fatal to animal life and improper for combustion. -

3° Heat, Light, & Electricity have no action upon it. -

4 It dissolves Phosphorus -

5th It forms Carbonic acid by exploding it with oxigene, or by passing it over metallic calcis. -

Lime Water — Priestly says the air is not produced by the decomposition of the Water but that it comes from the Coal he says too that coal contains phlogisticated Air when it cools in the Atmosphere but he is mistaken, for you see the air which I procure by immersing a coal under Water is the common air of the Atmosphere as I prove by the Eudiometer with which it gives an absorption of 89° this air is uncommonly pure, so very far from phlogisticated that it is within one degree as pure as the air of the Country i.e. 90° —

We need say but little of the method of preparing Charcoal as all of you must be acquainted with it, the Wood is cut in the Spring if it be split into small peices — Saplins answer very well for making Coal the Wood is dried in the Sun for 4 or 5 Months

or if the Weather is unfavorable or haste is requisite it may be dried in an oven, it is next heaped up into piles of a Pyramidal form these Piles are covered with Earth two holes are left in the Pile one for the purpose of letting out the smoke and the other to set the Wood on fire, the wood is now burned and when the smoke ceases to come out from the upper hole, the holes are both stopped and the fire extinguished—

Lecture 48th—

The next inflamable is Sulphur than which no substance has been more wrought on by Chemists, some called it Phlogiston or the inflammable principle, hence every inflammable substance was called a Sulphur —

Stahl first taught that Sulphur was a compound body, composed of Sulphurin Acid and Charcoal, the modern Gaseous

discoveries have detected completely his Error and taught us that it is compound of no two substances but is a peculiar Element — The experiment which first gave rise to this Hypothesis of Stahls was the Decomposition of Sulphuric Acid by means of Charcoal, he obtained Sulphur by adding Sulphuric Acid to Charcoal hence he concludes that the inflammable principle of the Charcoal united to the Sulphuric Acid and formed Sulphur — the fact is explicable in a different manner viz. by the decomposition of the Sulphuric Acid — its pure Air uniting to the Charcoal and its Sulphur being deposited in its simple form, we may therefore doubtless unite Sulphur with simple substances —

One third part of Sulphur fused with two thirds Alkali forms the Hepar Sulphuris — if Sulphuric Acid be added to

this substance it seizes the Alkali and forms vitriolated Tartar while the Sulphur is deposited this is also stable experiment

Heat applied moderately sublimes Sulphur if the heat be raised and the Sulphur comes in contact with flame it burns with a blue flame and a suffocating vapour is disengaged which is a true Sulphurous Acid, if the object is to obtain this acid Nitre is added to the Sulphur to facilitate the formation of the acid by its quantity of pure air, the operation is usually performed in Chambers lined with Lead and covered on the bottom with water to absorb the acid vapours. this water is evaporated and the Sulphuric Acid in a concentrated state is procured — Sulphur is insoluble in water, but by the addition of Alkali it becomes soluble —

The Sulphurs made with caustic Potash differ much from that made with the mild, these latter disengage more inflammable Air than the caustic both do this when moistened and to this Sulphurated hydrogene is owing their excrable smell, the caustic is of a deeper colour a dirty brown – the combination is stronger in the Caustic than in the mild – Tho' the mild Alkaline Sulphur disengages more Air than the caustic yet it is not so inflammable, owing to the fixed air which it contains, this is detected in it by Lime Water – The Sulphurs are decomposed by exposure to the Air, for the Sulphur is converted to the state of an Acid and unites to the Alkali forming vitriola. tartar

According to Mr. Prout Nitric Acid detonates with Sulphur and oxigenates it converting it to the state of Sulphuric

Acid – hence some Authors have asserted that Sulphur is soluble in Nitric Acid —

The oxigenated muriatic Acid also converts Sulphur into Sulphuric Acid – we prove that this happens by Muriated Baryte which instantly detects that acid, all the Acids decompose Liver of Sulphur by uniting to the Alkali, the Sulphur is left in form of a powder called Milk of Sulphur no effervescence is seen in this experiment if the Caustic Sulphure be used – If the Marine Acid be digested on Sulphur, the Sulphur which does not become oxigenated burns with a whitish yellow flame ——

We said the Sulphures of Alkalis disengage Sulphurated Hydrogene Gas, Scheele's method of procuring this gas in large quantities is to pour Sulphuric Acid on a mixture of Iron 3 parts and Sulphur 1 Part – this Gas is fatal to Animal Life, extinguishes a Taper turns blue vegetable substances green

white Metals black, & burns with a blue flame

Other methods may be used to obtain Sulphurated Hydrogene Gas, as to expose Sulphur to the focus of a burning Lens in an atmosphere of hydrogene Gas, the Sulphur fuses and is dissolved by the Hydrogene, the same effect is produced by the Electric spark

Either of the three Mineral Acids separate Hydrogene gas from Liver of Sulphur —

The only manner in which Sulphur can be united to volatile Alkali is to take equal parts of Sal Ammoniac and sifted quick Lime and ½ a part of Sulphur these ingredients are to be distilled when the Volatile Alkali and Sulphur unite, this forms the volatile Liver of Sulphur or Tinctura Volatilis Sulphuris so much extolled by Hoffmann in the gout —

Sulphur unites to Lime, Baryte, Magnesia and difficulty to Aluminous Earth —

Sulphur unites by fusion to, and is dissolved by the Volatile Oils, hence the Anisated and Terebinthinated Balsams of Sulphur, and hence also a quack Medicine made by pouring Olive Oil on a hot Brick and rubbing a roll of Brimstone on it, the Sulphur is fused and unites with the Oil and drops from the Brick of a red colour – If too much Sulphur be dissolved in hot Oil it will be deposited in the cold as neutral Salts are ——

Sulphur unites with all the Metals but Gold, Platina and Zinc, destroying their malleability and ductility, hence it is called a mineralizer – Sulphur has no action upon Animal and Vegetable substances, nor upon Water being insoluble in it

As to its Natural History, it is found in all parts of the Globe – Italy is little else than a bed of it – hence Bishop

Burnet supposes the Conflagration will begin there - It abounds also in the West Indies - It is found —

1st In the state of native Sulphur which requires only sublimation to render it perfectly pure, this is found at Gaudaloupe, it is sometimes found floating on Springs in form of Chrystals white and transparent - also opaque mixed with Earths, or in a vitriated form

2nd - Combined with Earth or Bitumen called impure native Sulphur, this is not so inflammable as the first species, and always requires sublimation, it is of different colours according to the various substances with which it is united, Bitumens generally under it black -

3d - Pyrites, these are combinations of Sulphur with Copper - Iron - Zinc

Arsenic and Alumine - they receive different names from these different substances - When Pyrites are decomposed by exposure to the Air and Green, blue or white Vitriols are formed according as Iron, Copper or Zinc is contained in them, if Alumine Alum is formed, this happens by the conversion of the Sulphur into Sulphuric Acid, which unites to those various substances - Marcasite which is synonimous with Pyrites - by Marcasite is meant Pyrites in chrystals - In Henckels Treatise De Pyritologia we find the following observations

1st - The more Copper Pyrites contain the less Sulphur & the more Iron the more Sulphur

2nd - All Arsenical Pyrites contain but little Sulphur the more Arsenic the less Sulphur —

3d - In All Pyrites which contain Sulphur without Arsenic, we may expect to find Copper —

4th - The more solid Pyrites are the more reason we have to suppose they contain Copper —

4th – Sulphur is found in various Metalic Ores, beside Pyrites, from them it is separated by several Methods – at the Solfatara between Rome and Naples in Italy it is separated altogether by sublimation, then it is fused and cast into cylindrical moulds to give it that form in which we see it —

Lecture 49th –

The next inflammable we shall notice is Phosphorus – This very curious substance was discovered in 1669 by Brandt a Bankrupt Merchant, who had turned Alchemist with the hopes of repairing his fortune by the discovery of the Philosophers Stone – Kunckel who flourished at the same time and who knew that Brandt used Urine in his experiments – set to work and discovered the very substance which Brandt had accidently done while endeavouring to extract a substance from Urine which should turn all the base Metals into Gold –

hence it is called both by the names of Brandts and Kunckels Phosphorus —

The method which was followed by the Ancient Chymists consisted in evaporating several Hogsheads of Urine, to a thick, black glistening extract, this is to be distilled with powder of Charcoal this last unites to the oxigene of the Phosphoric Acid and separates it from the Phosphorus —

Margraaf has proposed a better Method which consists in distilling the Muriate of Lead which remains after distilling 4 ℔ of Minium and 2 ℔ of Sal ammoniac with 10 ℔ of extract of Urine about the consistence of Honey mixed with ½ a pound of powdered Charcoal - after the more volatile matters are distilled off - the residue which contains the Phosphorus is to be distilled in an Earthen Retort, (Glass being too fusible) By this means more of the Phosphorus is procured than by the former Method —

A Gentleman of Turin has proposed

another mode of procuring Phosphorus — It is by decomposing a solution of Acetate of Lead by Phosphate of Soda, by this means Phosphate of Lead and Acetate of Soda are formed — the Acid of this Phosphate is to be decomposed by distillation with Charcoal, the Phosphorus comes over this is a very expensive method of making Phosphorus

The mode now commonly used is to calcine bones in an Iron Pot, Sulphuric Acid is added to this, which consists of Phosphoric Acid and Lime — the Sulphuric Acid seizes the Lime and sets the Phosphoric at Liberty, this last is decomposed by distillation with Charcoal — the oxigene of the Phosphoric Acid unites to the Charcoal and forms fixed Air (which may be received under the pneumato Chemic tub and is proven to be Carbonic Acid) when the heat is very intensely urged the Phosphorus comes over of a beautiful yellow colour

and about the consistence of warm Beeswax
It may be converted into Glass before the
distillation with Charcoal, if it be heated
in a Crucible —

Becher who was aquainted with this
animal Glass says that Man is glass
and may be converted into Glass — Homo
vitrum est, et in vitrum redigi potest si
cut et omnia Animalia — he reports that
the Scythians who drank out of Sculls
were not acquainted with this process of
converting them into Glass, he says it would
be possible to form a series of ones ancestors
in Glass in the same Manner as we possess
them in Painting — he says he conceals
the method on account of the various abuses
which might be made of it —

To purify Phosphorus it is pressed
like Mercury through a leather Skin
under water of a warm temperature, it
may be cast into moulds by pouring it while

fund into a funnel terminating in a long cylindrical tube (under water) the sticks may be used to write with the marks are luminous in the Dark —

Phosphorus attracts the Pure Air of the Atmosphere and is converted into an Acid if care be not taken to keep it corked up in a vial, if it be exposed to a gentle heat this combination is more rapid heat and Light are set at liberty —

Phosphorus is soluble in volatile Oils Oil of Cloves is commonly used the solution is luminous in the Dark and appears like fire, Boerhaave relates a pleasant anecdote of a Young Libertine who was reformed by this means — The Young Mans Tutor had cautioned his pupil and used every mode which prudence dictated to restrain him from his Libertinism but all in vain, at length he resolved on the

following Stratagem having procured some Phosphorus he wrote upon a wall opposite his Pupils bed a solemn admonition to inform or that Death overtake him, having written it while his Pupil was asleep he retired with as little noise as possible to the next Chamber and there contrived to make a noise so as to awake his Pupil, he awoke and with the greatest horror imaginable perceived the writing in letters of fire on the Wall of his Chamber, he called aloud to his Tutor, the Tutor came with a Candle in his hand, the instant the candle came into the room the appearance vanished - he persuaded the Young Man he had been dreaming and left the Room, no sooner had he gone than the Letters returned again

again he called his Tutor who took this opportunity to impress upon his already convicted Mind that this might possibly be a divine admonition, he further adds that the Young Libertine took it so much to heart as to leave off entirely his bad courses and the stratagem worked a complete reform —

A solution of Phosphorus in oil exists in the glow Worm and fire fly. one of these insects placed in a bottle of oxigene gas affords light sufficient to read the smallest print, it is said that the Female insects alone have this luminous appearance and that only at the time when they wish the Males to follow them —

Phosphorus is soluble in Alkohol this solution poured upon Water appears luminous in the dark tho' only

one grain of Phosphorus were dissolved in 1000 times its weight of Alcohol —

Caustic volatile Alkali digested on this substance disengages Phosphorated hydrogene gas which inflames as soon as it comes in contact with the Atmosphere provided it be dry and warm —

Phosphorus burned in pure Air emits perhaps the most vivid light imaginable

Phosphorus is insoluble in Water unless by a very long digestion in that fluid when a portion of it is dissolved —

Nitric Acid digested on Phosphorus inflames it, the oxigenated muriatic produces the same effect in a much more speedy manner, 20 or 30 flashes are often seen in the Nitric Acid but one is sufficient to inflame the whole mass in the oxigenated Muriatic —

The Phosphoric Glass, Chaptal

says is electric he observed strong electric sparks at the distance of 3 or 4 inches from the glass to his hand —

Phosphorus has been prescribed in Scarlatina Anginosa the form in which it was given was that of phosphorated Water, the patient appeared much relieved by it — By an accident some Water in which Phosphorus had remained a long time was thrown into a Duck puddle some of the Ducks drank the Water, it increased so much their venereal vigour that they began to copulate and Death alone stopped their embraces, they all died in a short time — A Gentleman who had observed its effects on the Ducks took some himself — the consequence was a violent priapism (For a further account of the action of Phosphorus see Philosophical Magazine Volume the 3d)

Phosphorus exists in vegetables as garden Cresses &c — very probably it is from Vegetables that Animals derive their Phosphorus

Phosphorus we observed is soluble in Hydrogen gas, it is this solution which constitutes Jack O Lanterns, Will o the Wisp and other similar phenomena which appear over Grave Yards and other places where Animal putrefaction goes on —

Lecture 50th —

We pass next to the consideration of the volatile oils

Aromatic Oils

These are oils more or less viscid & dense soluble in Alkohol with water, they vary in colour and specific gravity, some being heavier than Water others floating on its surface — they are all odorous and communicate a pungent taste to the Tongue, this taste is more or less Acrid — they are so evaporable as to be frequently called Volatile Oils they evaporate in a very low temperature —

If a drop of volatile be put on a peice of white paper and held over the flame of a candle the Oil evaporates before the paper is scorched. the odorous principle of these Oils is communicated to water very readily by agitation

These Oils are obtained by the distillation of several plants which afford them Water is put into the Still so as to intervene between the plants and bottom of the Still and so prevent their contracting an Empyreuma - the oil rises and passes into the Refrigeratory - before this however a portion of Water impregnated with the Oil and their Acetous Acid - (the water is usually boiled before the plants are put into the still) the Oil which comes over last floats on the surface of the Water - a Coffee pot is the most convenient recipient for it as the Water may be poured out from under the Oil & so the two fluids separated - the Oil becomes darker in colour and thicker in consistence

as the distillation proceeds. the Water which comes over is called Simple or distilled Water of the plant made use of and is sometimes used in Medicine after the distillation the residue consists of Carbone —

Sulphuric Acid blackens the Aromatic Oils and emits fumes when poured on them —

Nitric Acid unites to them with violence and impetuosity flame is generated — Rouelle who has written on the inflammation of volatile oils by the Nitric Acid says that Butter Lard Fat and any other oily substance whatever may be inflamed in this manner, provided the Acid be sufficiently concentrated — Rouelle directs to add Sulphuric Acid to the Nitric in order, he says to abroil the Water from the Acid and so permit it to act with greater force —

Marine Acid has little or no action on them —

They have little action on the Vegetables

Acids unless very highly concentrated —

Their affinity to the Alkalis is nowise unmarkable — Starkey endeavoured for a long time to unite an Aromatic Oil & fixed Alkali, he succeeded at last but it required 5 or 6 Months to perform the operation — during which time the Alkali became volatile and so united to the Oil, this combination is called Starkeys Soap. Mr. Baume has discovered a more expeditious method of uniting them viz. by rubbing them together on a flat Stone of Porphyry, the vaporation goes on so briskly by this contrivance that the union takes place in a very Short time — Mr. Geoffroys method is to mix 6 Parts of hot caustic alkali and 8 of hot oil of Turpentine and rub them well while hot in a Mortar, the combination is thus produced in a very few minutes. It is a composition of no use worth the trouble of making it —

The neutral Salts have no action on Aromatic Oils —

The Earths have likewise no action on them —

They dissolve the Resins forming varnishes. the oil easily evaporates and leaves the resin on the varnished substance —

They are as before said soluble in Water and lose their odour by uniting to it but if they have lost their fragrance and consistence and consistence they acquire it by a second distillation with that fluid —

Aromatic oils act on the calces of Lead and other Metals they precipitate Gold from its Solution in Aqua Regia —

They exists principally in Vegetables and in every part of them, the Bark, wood, pith, Seeds, &c — all contain it — from being so generally diffused though the plants, they appear to constitute the essence of it. they have therefore obtained the name of essential Oils —

They differ from each other in many particulars, some are highly acrid to the taste others are pleasant and mild, some are congelable by a slight degree of cold as oil of Anised while others always retain the fluid form some are easily soluble in Water others sink to the bottom of it and others float on its surface - this difference Boerhaave thought, to be owing to the difference of what he called the Spiritus Rector in which the aromatic part consisted —

The pith of Laurus Sassafras & Laurus Benzoin yield a very pleasant fragrant aromatic Oil —

Camphor is a solid white substance of a very pleasant smell, it does not come properly under the head of Aromatic Oils it is a substance Sui generis which cannot be classed - It resembles resins in being soluble in Alkohol - like them also it is inflammable, burns with a handsome

white flame hence Jugglers and Conjurors by rolling a piece of Camphor in snow, setting the Camphor on fire, they deceive the Ignorant who think the snow itself burns —

Marquer has compared this substance to a concrete Ether as it is very volatile, and assumes the gaseous form before the intervention of that of a liquid —

Sulphuric Acid dissolves it and emits copious fumes —

Marine Acid likewise emits fumes and dissolves Camphor —

Nitric Acid distilled frequently from Camphor produces a very peculiar Acid called Camphoric - The Camphoric Acid differs from the Oxalic in not precipitating Lime from its solution - Heat and fumes are generated by adding this Acid to water - It reddens Litmus and possesses the Characteristics properties of Acids in general —

Camphor is not much altered by solution

in Acids - if precipitated by Alkalis it is harder, more solid, compact and combustible than before the solution ——

Water does not dissolve Camphor yet it becomes charged with its odorous principle if digested in it ——

Camphor has no attraction for the Earths tho' Neuman says it may be united with Red bole —

Camphor is soluble in Oils and Alkohol the latter is its proper Solvent, water precipitates it from Alkohol in beautiful chrystalized flakes which float on the surface of the Menstruum — Tho' Camphor is very volatile yet if its solution be distilled the Alkohol rises first, if the heat be urged so that the Alkohol inflames the Spirit all burns first and then the Camphor ——

According to Lemery if Camphor be dissolved in Oil of Turpentine and the solution distilled both oil and Camphor rise together Neuman denies this in a very positive manner, and says that a red heat may

be given to Camphor thus dissolved before volatilization provided the heat be suddenly applied —

Camphor has no Action on Metals —

It may be united to Water by the intermedium of the white of an Egg or other mucilaginous Matter —

The solution of Camphor is useful in destroying insects as Moths &c — and is very powerful antiseptic to Animal substances —

As to its Natural History — It is procured from a tree in Japan, Borneo & Sumatra, this Tree is a species of Laurel some of those Trees are of considerable size and upon splitting pieces of pure Camphor are often found in lumps — the most usual method of obtaining it is by distilling pieces of the Wood in an Iron Still, the Capital of the Still contains Straw, the Camphor rises and is attached to the Straw. Travellers tell us that pure Tears of Camphor

are often found on the surface of the Tree

The Camphor of Commerce is imported from the East Indies and purified by the Dutch, who valuing every thing in proportion as it is connected with the art of making money kept the purification of it secret for a long time, many vain attempts were made to discover the process - and Mr. Marquer to whose labours Chemistry is much indebted has discovered that the purification consists in distilling in an Iron retort one part of Camphor and ½ part of Quick~~lime~~ slacked in the open air - a Balloon or receiver is adapted - the Camphor rises and sublimes to the sides of the receiver hence its globular form -

The Laurel of Borneo is not the only Tree that yields Camphor it may be procured from the husks of the seeds of Cardamon - the Laurus Cinnamon, Zedoary

Rosemary - Thyme - Pulsatilla - Anemony - Elicampane &c - These plants are denicated usual months say 4 or 5 and then distilled Lavender and Peppermint thus treated afford much Camphor —

Lecture 51st —

We pass next to consider another substance sui generis viz. Benzoin — This is a hard dry inflamable substance which possesses a very pleasant smell if gently heated —— Benzoin is fusible in a gentle heat and evaporates in fumes of beautiful white flowers, Sand under the Benzoin capable of having a greater degree of heat without fusion, if distilled from sand a sort of Oil is obtained ——

Benzoin is soluble in aromatic oils but its proper Solvent is Alkohol —

To make the flowers of Benzoin Mr. Baume has proposed to use two Iron pans - the Benzoin is put into one

of them which is covered by the other the flowers rise and are condensed in the upper pan, the heat must be gentle or else the Benzoin contracts an empyeumatic smell —

Water precipitates the solution of Benzoin in Alkohol in the same manner as it does Camphor. this precipitate is of a beautiful white colour & called Lac Virginalis. it is used by the Ladies as a Cosmetic and is the only one that can be used with impunity, as all the minral Cosmetics destroy the beauty of the skin —

Benzoin like Camphor is procured from a species of Laurel called Laurus Benzoin, this Tree grows in Japan, Borneo, Sumatra and other Islands near the East Indies — This Tree is said to have been found in Virginia and Carolina

but this not yet fully ascertained — Benzoin forms the principal ingredient in a celebrated Quack Medicine, called Turlingtons Balsam, it is recommended by some in fresh incised wounds but it is certainly improper being a powerful Stimulant, it may be used with more propriety in old languid Ulcers in this manner they use it at St Bartholomews Hospital and some others —

Resins & Balsams differ from each other in consistence only, they contain more Acid than Aromatic Oils — in distillation they yield Water, an Oil and an Acid of the Vegitable class, a large quantity of Carbonaceous matter remains in the Retort — They are inflammable — their Soot forms Lampblack of which when burned they afford a large quantity — Most of the Lampblack

of Commerce comes from Sweden it is obtained there by burning the impurities of Resins after they are strained — the Soot is collected in a long square Chimney which grows narrow as it approaches the end and finally terminates in a woollen bag this bag is beat with sticks and the Soot knocked off by this means and is taken out every two or three days —

Resins are fusible by a moderate degree of heat. soluble in Alkohol and volatile Oils with them they form varnishes the latter are said to be best — the oil of Turpentine is commonly used for this purpose —

Resins have no affinity to the Earths or Metals are insoluble in Water when pure — Gum Resins are partially soluble in this fluid and Resins by the intervention of a Mucilage may be

dissolved or suspended in Water – Yolk of an Egg may be conveniently used for this purpose as also Gum Arabic, Gum Tragacanth &c &c – for an account of such Medicines Refer to the different Writers on the Materia Medica

Unctuous Oils – are more slippery smooth bland and inflammable than the Aromatic, they are used to lessen friction in Wheel Carriages on account of their smoothness – they are perfectly bland and inodorous, insoluble in Alkohol and Water, they do not differ so much as the Aromatic in their specific gravity as they all float on Water ~~if~~ If heated to 212° a spluttering crackling noise is heard owing to the dissipation of the Water they contain if heated to 400° or 500° they emit copious fumes and an unpleasant smell if to 600° –

their steams take fire if in contact with a flaming Body —

In distillation they afford Charcoal Water & an Acid - By a considerable degree of heat they contract an Empyreuma

Sulphuric Acid added to Unctious Oils emits copious fumes and under it pitchy

Nitric Acid afford a substance of the consistence of Cornatum —

The Muriatic does not act so powerfully —

They unite to the fixed Alkalis forming Soap as this is an Article of considerable use we shall here make a few observations on it —

The best Soap is imported from Spain - Italy and the Mediterranean coasts of France, It is there made from fossil Alkali procured by the combustion of Thali and fresh Olive Oil, the green colour is given to it by the leaves of beets —

Venice in Italy and Castile in Spain are famed for the Soap which they export, hence all soap from the Continent of Europe is called Castile or Venice Soap, the mode of preparing the Alkali is to make a lixivium and add 1/3 of Quicklime to render it caustic by attracting its fixed air, this Ley is boiled untill its specific gravity is the same as that of Water, or untill 16 2/3 fill a pint measure - three parts of oil are now to be added to two of the Ley & they usually coagulate, if this effect does not take place the Ley is not sufficiently caustic and fresh Quicklime must be added, or what is better common Salt or what is best of all pure Soda, they are suffered to stand in a large tub for some time —

The Soap made in this Country consists of Soda and an Animal Oil

Fat of Animals, Lard, Suet, &c - are used
Ley is made of vegetable ashes as is usual
to procure Potash, this solution of Pot-
ash is decomposed by the addition of
common Salt - the Marine Acid of the
common Salt unites to the vegetable Al-
kali while the Soda is set at liberty
this is added to the Fat and forms the
Soap - The common soft soap of Laun-
dresses consists of vegetable Alkali and Ani-
mal Oil this is boiled till it acquire a
proper consistence quicklime is often ad-
ded to under the Ley Caustic —

Chaptal who has had some experi-
ence in the manufacture of Soap from
Wool and Alkali has made the follow-
ing conclusions —

1st That as soon as the Wool is put into
the boiling Alkaline lixivium the filaments
adhere but by a slight agitation are com-
pletely dissolved ——

2nd. That the ley becomes coloured and thickened as the Solution proceeds —

3rd - That the Soap is more or less coloured or white in proportion as the wool is dirty or clean —

4th - That the piles or hair which the Wool contains is more difficult of solution than the Wool itself —

5th - That the quantity of the Wool soluble in the Lixivium depends on the causticity, heat and strength of the lixivium —— For an account of the Manufacture of Soap from Wool, see Nicholsons Chemical Journal Vol. 1st in which is a memoir on the subject by Chaptal - 1 ℔ - 3 ℥ - 6 ʒ of caustic Alkali at 12° of concentration and 112° of heat dissolves 10 ℥ 4 ʒ of Wool, the soap when cold weighs 1 ℔ 4 ℥ —

Unctuous Oils have no action on any of the Earths, excepting Quicklime with this it forms a kind of Soap soluble in Water

this Soap is capable of dissolving Sulphur and forms a Balsam of Sulphur without —

Unctuous Oils are insoluble as we before said in Alkohol —

If heated with the Calces of the Metals they revive them by abstracting oxigene from them, in this manner they become very drying and rancid if they contain Mucilage which ferments

They have no action upon Iron but preserve it from rusting hence Iron Utensils are often guaed —

They are antiseptic - Eggs dipped in Lard may be preserved for a long time in Sea voyages —

The Rancidity of an Oil is destroyed by washing it in Water which carries of the Mucilage —

A remarkable property of unctuous Oils has been discovered by Dr. Franklin it is that of smoothing the surface of rough

Waters, the Dr. made some experiments upon a pond near Clapham and found that a teaspoonful of oil spreads itself over a space of ½ an Acre of Water and tho' the Water was very much agitated by the Wind the Oil rendered it as smooth as a Mirror a Ship belonging to the East India Company was saved by 5 or 6 Demijohns of Olive Oil from being wrecked on the Coast of Holland – This valuable property enables the Fisherman at the bar of the Tagus to cross in small boats when the surf was before very terrible and dangerous – The Bermudian Sailors always observe this precaution of throwing oil on the Water when they intend to catch Fish by the Spear, Harpoon or Gig – Hence also the Pearl Divers in the Mediterranean take a Mouthful of Oil to the bottom, and if the Waves

on the surface disturb the direct passage of the Light they let the Oil out of their Mouths and as it rises it so smooths the surface that they can see with the greatest ease ——

Lecture 52nd —

Bitumens are Inflammable substances differing in colour and consistence some are fluid as Naptha, this is a very light volatile body very inflammable but what is curious does not inflame by a spark produced from the collision of a flint and steel — hence the Workmen in Mines where Naptha is found use this light to work by, for this purpose a wheel of flint which strikes against an Iron stove and so produces light enough to see by plainly, is made use of —

Petroleum also is a fluid Bituminous substance which issues from the crevices of Rocks on the Banks of certain

Rivers in Germany and France — and other western parts of Europe — In these Countries where it abounds the Petroleum is mixed with Earth and put upon a Hearth to be used as fuel it burns with a gentle heat and light which may be increased by stirring it up frequently —

Petroleum burns on the surface of Water in this manner the Ancients used to fire their Enemies Ships at a distance —

Petroleum has lately been used in Medicine to cure the Tape Worm the Jews in grand Cairo use much of it in this disease and also Barbadoes Tar ——

Amber is a solid Bitumen tho' no doubt it was originally fluid, for flies and other Insects have been found in the middle of the most solid pieces of it — It is found on the Seacoasts of most Countries its colour is beautifully yellow and transparent — Amber is possessed of a

remarkable property of attracting small feathers and other light substances, this however is by no means peculiar and merely owing to Electricity – hence the term Electricity from the Greek word ΕΛΕΚΤΡΟΝ which signifies Amber —

Amber by distillation yields first an Oil light and known by the name Oil of Amber, then a Salt which was formerly thought to be of an Alkaline nature but which is now proved to be purely acid, as it reddens Litmus and possesses most other Acid properties – this Acid is emitted in form of fumes when Amber is thrown on hot coals, they are very active in exciting coughing sneezing &c – if there were a thousand people in the Room when Amber was treated in this manner all of them would perceive its operation in this manner, the residue in the retort after distillation of Amber is entirely Carbonaceous

It has long been a desideratum in Chemistry to dissolve Amber, could this be done the smaller peices might be dissolved and precipitated in form of a large mass and valuable peices of Furniture be thus obtained - Acids united to spirit of Wine soften it but from this imperfect solution it cannot be seperated in large peices - Mr. Lewis has proposed Linned Oil this dissolves Amber and forms a very beautiful varnish with it but it is liable to the same objection as the Acid solution, that of not being seperated in large peices —

It is found on the Coasts of most Countries in peices of from 4 to 5 lb. weight seldom larger and more frequently smaller -

Ambergrise appears to be compound of laminated plates or strix, resembles Amber but is somewhat softer — Its

lation to the different objects of Chemistry are similar to those of Amber, excepting that it is soluble in spirit of Wine if highly concentrated — It is likewise found on the Sea coasts so plentifully in Africa that the Negroes use it to paint their Canoes and fishing boats with ——

We pass next to consider the vegetable acids —

The Vegetable Acids resemble the Mineral in their general properties and possess them all in an inferior degree they turn blue vegetable colours red form neutral Salts with the Alkalis and effervesce with them their relation to the objects of Chemistry are however materially different from that of the Mineral Acid

Citric Acid This acid exists in the Lemons Oranges Citrons &c — Also in the Juice of unripe Summer Fruits — as

Apples, Peaches, Pears, Plumbs, &c — the simple expression of those Juices is not sufficient to procure the pure Acid mucilage and Sugar exist in it and must be separated —

If heat be used to separate it the Acid contracts an Empyreuma if the mucilage be not separated it ferments and the whole is converted into Vinegar — If the heat however be very gently applied and carefully managed the Empyreuma may be prevented and the Juice evaporated to the consistence of Syrup. it may then be chrystalized — If Alkohol be added to the Juice it prevents the moulding of the Mucilage —

We are indebted to scheele for procuring this Acid in a state of Purity — he directs us to express the Juice add chalk in powder till the effervescence ceases, then wash the insoluble Citrate of Lime which is formed

by the union of the Lime and Acid - this Citrate is decomposed by the addition of Sulphuric Acid which seizes the Lime and leaves the Acid in a disengaged state - the Acid is diluted with 10 times its weight of water before it is added - the liquor which remains after the addition of the vitriolic Acid is a solution of Citric Acid to be evaporated and chrystalized ———

Mr. Georgius has proposed another method of procuring it - it is to expose the Juice of Lemons for a long time in inverted vials in a cool cellar, a spontaneous separation takes place between the mucilage & Acid - Also by freezing the Juice, the Water and mucilage freeze while the Acid remains in the middle of the vessel in a fluid form by this means the liquor is reduced to about one eight of its bulk & is eight times as strong - It unites with Potash and Soda forming deliquescent Salts - Doctor Cullen says he

has tried as Medicines the Juice of several Summer fruits Apples Pears &c – but finds the Citric Acid or Juice of Lemons to answer best –

The Citric Acid acts on Copper, Lead & Iron also on a few other Metals, hence we must be cautious how we use Lemon Juice after it has been long standing in Copper Vessels –

The Citric differs from the Oxalic acid in not precipitating a solution of Lime – Nitric does not convert the Citric into the Oxalic acid as it does most of the vegetable Acids

Citric Acid is powerfully Antiseptic and used by Dr. Trotter as a Diuretic Dr. Trotter has used the Sulphuric Acid, Juice of Pears Apples &c – in Scurvy with no advantage and cured the Patient by Citric Acid – he used it in some cases in the Dose of a quart a day, the Sulphuric Acid in one case had been used a long time without any advantage but within 24 hours after the use of the Citric Acid a change was perceived

for the better - Dr. T. thinks the Acid acts by giving out its pure Air which is taken into the Circulation - Before we admit this Hypothesis it is proper to enquire whether the Scurvy be owing to a deficiency of oxigene - Sir John Pringle ascribed it to putrefaction - Mac Bride to - Millman to an immovability or debility of the simple Fibre - Cullen to an excess of an Ammoniacal salt in the Blood - and the Celebrated Theory of Beddoes which Dr. T. adopts is that of a deficiency of oxigene - Before we agree with Drs. Beddoes and Trotter I would beg leave to ask - whether does Scurvy ever arise from a polluted Atmosphere - the Answer must be in the negative, but say they the polluted Atmosphere generates a disease which moves Mortal before time is allowed for the Scorbutic action to appear, or at any rate being much greater in force overpowers it

I would also ask, why does not the removal to a pure Atmosphere always cure Scurvy, and why is not the constant supply of it, which the Blood every minute receives in the Lungs sufficient to cure the Scorbutic action - Why say they because that Air is destined for some more important purpose in the Animal Oeconomy Doc: Beddoes says the reason why Sailors are more afflicted with Scurvy than Landsmen is that Sailors respire a less pure Air here he is undoubtedly Mistaken —

Malic Acid or Acid of Apples is procured from the Juice of ripe Apples — It appears that the Citric (which exists in the apples before maturation) into the Malic the Acid becomes more wrapt up in Sugar and Mucilage as the Fruit becomes ripe — Scheele has invented the best method of procuring this Acid in a separate State

his method is to express the Juice or ripe Apples and saturate the Acid they contain with Potash this combination forms a salt which may be crystalized - Acetate of Lead is added to the Malate of Potash, a double elective attraction ensues the Acetic Acid of the Acetate of Lead unites to the Potash of the Malate, while the Malic Acid unites to the Lead forming Malate of Lead which is insoluble and fall to the bottom this Malate of Lead is decomposed by the Sulphuric Acid which seizes the Lead and the Malic Acid by evaporation may be obtained in form of crystals —

Malic Acid forms deliquescent Salts with the Alkalis - Nitric Acid converts the Malic into the Oxalic Acid ——

The principal Metals acted upon by the Malic Acid are Iron and Zinc —

Oxalic Acid or Acid of Sorrel was formerly procured by crystalizing the expressed Juice of the Sorrel by spontaneous evaporation in the open Air, the method now in use consists of originating Sugar for this purpose Nitric Acid is poured upon Sugar in the proportion of 8 or 10 parts of Acid to one of Sugar, this Acid is evaporated by heat till all the red fumes disappear the residue in the retort is Oxalic Acid which may be crystalized by standing in a cool place - these crystals are to be dissolved in Water — Scheele first taught us that the Acids of Sugar and Sorrel are the same, before Scheele's discovery Bergmann called it the Saccharine Acid - Bergmanns mode of procuring it consists in adding ℥iij of diluted Nitric Acid to ℥i of Sugar in powder, this is to be heated till the red fumes cease to come over, then ℥iij more of Acid are to be

added and treated in the same manner by cooling chrystals are now obtained which weigh ℥ijß and 19 grains, by evaporating & chrystalizing the supernatant liquor ℥ß. & 19 grains more may be procured —

In the above processes the Nitric acid is decomposed, its pure Air oxigenates the Sugar while its Azote and a small portion of its pure air escape in form of Nitrous gas — Sugar is not the only substance which affords the Oxalic Acid by oxigination Gum Arabic and Alkohol also afford it — Hermstadt and others have procured it from the Calculus concretions in the Bladder and Liver, it may indeed be procured from almost every Animal and vegitable substance by treating it with Nitric Acid — Scheele procured it from Sugar of Mint —

The Oxalic Acid is much used as a test for Lime it forms an insoluble

compound with that substance and detects a very minute portion of it - Fourcroy prefers the Oxalate of Ammoniac for this purpose but the Essential salt of Lemons which the Apothecaries sell to take Stains out of Cloathes and which consist of Potash and the Oxalic Acid answer equally well — Oxalic has been converted into the Tartarous Acid & vice versa —

Lecture 53rd —

Tartareous Acid differs from the Acetic in not forming a Sweet compound with Lead and a deliquescent Salt with Potash which Salt is soluble in Alkohol —

The most usually found combination of the Tartarous Acid is Cream of Tartar. Tho' it exists natively in certain Plants as the Rhus Glabrum in which it is combined with Potash and a portion of the Gallic Acid. It is procured in a state of purity by dissolving the Cream of Tartar

in Water and adding pounded Chalk, the acid unites to the Lime of the Chalk and forms a Tartrite of Lime which is 3 times heavier than the Chalk used, consequently contains 3 parts Tartarous Acid for one of Lime, Sulphuric Acid is added to separate the Lime with which it forms Gypsum, this Tartrite of Lime is insoluble in Water and must be well washed in order to separate the Tartrite of Potash which may adhere to it before the Sulphuric Acid is added – Prejudice alone authorizes the use of the Chalk, three times as much of the Acid may be procured by Quicklime, for when Chalk is used the tartarous Acid only unites to the surplus of Lime which exists in it, whereas the whole of the Lime becomes saturated if Quicklime be used. the proportion of Sulphuric Acid (which is diluted with ten times its weight of water) is three to one –

the liquor must be chrystalized and the pure Tartarous Acid will be procured in a solid form — Mr. Weiglib has proposed Oyster shells as being preferable either to Chalk or Lime - 1 lb of Cream of Tartar treated in the Manner above mentioned with 5 ounces of Sulphuric Acid yields 5 ounces of Tartarous Acid —

The Acid thus procured reddens blue vegetable colours, effervesces with Alkalis — Tartarous Acid may be converted into Oxalic Acid by oxigenation with Nitric Acid

The chrystals of Tartarous Acid are soluble in Alkohol and Water - it forms chrystalized Salts with the Alkalis - with Soda - Sal Rochelle - Sal Sygnette - Sal Rupellensis &c &c — or much more properly tartrite of Soda — with Potash - Soluble Tartar - if not fully saturated with Alkali it forms the Cream of Tartar - with Lime it forms a Salt

not soluble in Water - Its affinity for Water is slight requiring 24 times its weight of that fluid for its solution, With Antimony it forms Tartar Emetic It has no remarkable action on Animal or Vegetable substances —

It exists naturally in certain plants as the Rhus Glabrum, the Berries of which are covered with a crust or pellicle of a whitish Salt consisting of Gallate & Tartrite of Potash - It is deposited on the sides of Hogsheads and Casks containing Wine Rhenish Wine affords the most of it, they are much improved by this deposition and are then called Old Hock - the more they deposit of this Salt the better they are - It differs much in purity sometimes it is red and sometimes white the whiter the pure - Tartar always contains Potash, which may be proved by deflagration with Nitre - this

this Alkali is very pure and is called Salt of Tartar - The high red Wines afford the least Tartar - When large quantities are wanted of the Cream of Tartar Wine lees are boiled and the Tartar rises to the surface forming a pellicle then which is skimmed off hence its name of Cream of Tartar ——

Gallic Acid or Acid of Galls so called because large quantities of it exist in Oak Galls, this is found in most astringent vegetables, tho it by no means constitutes their astringency, as has been supposed, many vegetables contain it which are not astringent and vice versa many vegetables are astringent which do not contain it — The Rhus radicans contains much Gallic Acid yet it has no remarkable astringency — the Rhus contains it yet is not astringent - Hoes &c - are in the same situation The Gallic Acid for experiments is usually procured by Scheeles Method this consists

in digesting 1 ℔ of oak Galls in 6 ℔ of Water for 15 Days the liquor is then filtered and exposed to the Air for some Months when a Mouldy pellicle will form on the surface. this falls down and Crystals attach themselves to it, these Crystals are separated — the liquor is again filtered and evaporated when Crystals of the Acid are obtained but so united to the mucilage that Alkohol must be added to dissolve them (for Alkohol has no action on mucilage) the Crystals are of a yellowish brown colour —— Nitric Acid converts the Gallic into the Oxalic Acid ——

It unites to the Alkalis forming neutral salts

It precipitates Iron of a black colour (and hence is used to detect it) forming Ink

Gallic Acid may be procured in a state of purity by distilling the Juice of the unripe persimmon ——

Formic Acid — or Acid of Ants —

These little industrious Creatures have the power of discharging when irritated an acid liquor which under their Sting peculiarly painful, this Acid may be collected either by immersing them in Water or Alkohol or by distilling Ants in a retort —

This Acid forms liquid Salts with Soda and Ammoniac —

Formic Acid dissolves Coral Quicklime and other Calcareous Stones —

It has no remarkable action on Inflammable substances - It dissolves the calces of Silver Zinc and Copper, it has no so much action on them in their Metallic state - the calx of Copper dissolved forms a green chrystalized Salt with the Formic Acid - The Formate of Zinc chrystalizes like the Acetate - Bismuth is not acted on by Formic Acid —

It is procured as we just now said from Ants - the Ant hills appear to be

impregnated with this Acid as they will redden blue vegetable colours immersed in them - the Odour is similar to Hartshorne and it has been mistaken for that substance It appears to be a secreted liquor of the Ants —

Bombic Acid or Acid of Bees is a liquor secreted by Bees, Wasps, Hornets &c — and is procured from these Insects in the same manner as the Formic Acid from Ants — Its relations to the different Objects of Chemistry is very similar to those of Formic Acid —

Some Gentlemen has attributed the cause of the Pain and inflammation in the sting of Bees &c - to this Acid being effused into the wound - But why do not other vegetable Acids produce the same pain when put into a wound - do we not use vinegar and to cleanse Ulcers without producing any thing more than a little transitory itching Pain - those who will take the trouble to examine the wounds

made by the sting of the Bee in flesh by means of a Microscope will want no other cause to what to attribute the Pain & — nothing can have a more ragged aspect than the wound — Again if it be this Acid which gives the pain how does it happen that they cannot sting more than once and that they are Drones ever afterwards, they probably leave their stings in the Wound, as the Poet expresses it —

Animas que in Vulnera ponunt —

The next in order is the Acid produced in Fermentation — Acetous Acid or Vinegar is never procured in a state of perfect purity always combined with Water — Macquer directs distillation to concentrate it — but it very apt to require an Empyreuma — and the Vinegar being nearly as volatile as the Water rises along with it — Stahl has proposed freezing as a better method as the Water alone freezes and the

Acid remains in a liquid state - 4 pounds by this means is reduced to half a pound and is of course 8 times as strong - Mr. Higgins has proposed the distillation of verdigrise the Acid comes over in a very concentrated state by this means - he also proposes to distill Terra foliata Tartari with the Sulphuric Acid this last acid seizes the and the Acetic Acid in a very concentrated rises into the receiver ——

Acetous Acid forms Neutral Salts with the Alkalis with Potash - Terra foliata Tartari or Sal diureticus, also Regenerated Tartar, the method of forming it is to put a quantity of Potash into a wide shallow basin and adding Acetous Acid untill the effervescence ceases the excess of Vinegar is next to be evaporated and the Salt is obtained in a solid mass this mass is fused by heat, dissolved in Water and chrystalized — With Ammonia it forms Spiritus Mindereri ——

It corrodes Copper forming a green compound called Verdigrise, and if sufficiently concentrated dissolves it, the Copper for this purpose is extended into Lamina and stratified with Grape stocks, these are moistened with vinegar and ferment, the vinegar produced in the fermentation corrodes the Copper forming the Verdigrise which is scraped off (in Copper) treated in the same manner with Lead it forms Cerusse - Cerusse mixed with about 1/3 of Chalk forms the White Lead which is used by Painters - this Cerusse is a Calx of Lead - If more Vinegar be boiled on it is dissolved and rocktish chrystals are formed called Saccharum Saturni or Sugar of Lead, this however is most usually made by boiling vinegar on red Lead or Lithargy which contain more pure Air than Cerusse —

Vinegar distilled from Copper or Zinc is very apt to retain some deleterious properties of those substances - but that from Sugar of Lead is quite as concentrated and possesses none of those qualities, the mineral Acids are not

stronger than the Acetic thus procured—

Mr. Lowitz a Russian Chemist has decomposed the Acetous Acid and finds it to consist of two Acids, the one he thinks is Phosphorus the other a peculiar Acid different from all others, the mode of decomposition was by distillation in contact with Charcoal—

The above described Acids appear to be composed of the same elementary principles and have by differently proportioning those principles been converted into each other

1 Spirit of Wine distilled with 20 times its weight of Caustic Alkali, is converted into Vinegar — Water also is afforded in the distillation

2 Spirit of Wine distilled with Manganese is converted into Acetous Acid —

3 Two parts of Tartarous Acid, four of Manganese and three of Sulphuric Acid form Vinegar and a small portion of Sulphuric Acid is left—

4 Eight parts of wine added to one of Acid of Tartar, dissolved in Water and heated gently

for three Months are converted into Vinegar

3- All the Acids by being treated with Nitric. may be converted into oxalic Acid excepting the Acetous —

The above are the conclusions of Mr Kehl from many experiments on the subject

Lecture 54th —

Fermentation is a spontaneous motion which certain bodies undergo by means of which their properties are considerably changed —

Three things are absolutely necessary in order that Fermentation may take place - 1st Contact of pure Air - 2nd A certain degree of Moisture - and 3rd A Degree of Heat —

1st The Contact of Air is so necessary than no fermentation can go on without, experiments with the Air Pump have put this matter beyond a doubt and we know that liquids kept from the Air may be preserved a long time from putrefaction —

2nd Moisture is also requisite, Sugar is

very much disposed to the fermentative process, yet Sugar may be kept for Ages in a sound state if it be kept from Moisture —

3rd Heat is indispensible for a perfect fermentation — the most fermentable materials may be kept sound in the Cold —

There are three kinds of Fermentation — 1st Vinous — 2nd Acetous — and 3rd the Putrefactive — Alkohol is the product of the first — Vinegar of the Second — and Ammonia of the Third —

They do not always take place in the order here set down, for very often the Acetous takes place first as in Cyder — and the putrefactive without either as in ripe Apples &c —

Sugar is necessary for the first — Mucilage for the second — and Gluten for the third fermentation — hence we may account for the different fermentation which different substances undergo, those in which Sugar abounds undergo the Vinous first — those

in which Mucilage the Acetous - and those in which Gluten the Putrefactive —

There is also a generation of Heat in Putrefaction - this is about 10 or 12 Degrees an absorption of pure Air also takes place the greater the bulk of the fermentable matter the more speedy will be the fermentation - because more pure Air is decomposed and of course more heat evolved which much spirits the process —

Sugar we said is the subject of the vinous fermentation, but from some facts it appears probable that certain Animal substances are liable to the Vinous fermentation. e.g. The Tartars prepare a kind of Rum from the Milk of Asses, Mares, Cows, Goats &c - for this purpose the Milk is suffered to stand till it coagulates (of course till it is sour) this Bonny Clabber is churned with the Whey which seperates, it is then suffered

to stand for 24 hours and by distillation yields one third part of Spirit – They procure it also from Fish – the Chinese from Lambs Flesh – also Sheep, Goats, &c – The Swedes get a kind of ordinary Wine from distilling a large species of black Ants (which inhabit the roots of certain Trees) with Rye

Rum is procured from Sugar in the West Indies – Tafia from Molasses – Arrack is procured from Rice Whiskey from Wheat or Rye – Beer is procured from Barley, Hops is added to check the tendency to the Acetous Fermentation – Several other grains will yield it but Barley is most commonly used –

The Barley is thrown into Water the grains which float on the surface of the Water are not good and must be separated – the Barley is steeped in this Water (which must be kept warm)

till it begins to germinate or sprout out, by this time the Farina is converted into Sugar and Sweet taste evolved - this is called Malt - the Water used in forming the Malt has an influence on the result, Pond or River Water should be used for this purpose probably because they contain more impurities and filth - It is thought that the London Porter owes its decided superiority wrs ours to the circumstance that the Brewers use the Water of the Thames which contains much filth and the reason why October Ale is better than any other is, because the rains which descend in that Month wash a greater than usual quantity of Excrementitious matter and filth of all kinds into the River - hence we understand Smollet when he tells us in Humphrey Clinker that Human excrement is perhaps the cleanliest thing we drink in Beer - to return The Malt is dried and ground into a coarse Flour, this flour is steeped in Water - the

heat of this Water should not be too great, a Thermometer is commonly used to determine it, 100° Farenheit answers exceedinly well — This Wort as it is called is put into large Tubs or Coolers - Yeast is added and the fermentation proceeds after this is over the Beer is barelled and fit for use —

Gums Jelly and all Mucilaginous matters are liable to the Acetous fermentation - The French Chemists say that in the Vinous fermentation Water is decomposed the Hydrogene Gas unites to the Charcoal of the Saccharine matter and forms Alkohol while its oxigene unites to another part of the Coal and is dissipated in form of fixed Air, what takes place in the Acetous is not so clearly understood —

Mucilage, Heat and pure Air are necessary to the Acetous Fermentation —

The external coat or Husk of Pears may be made to undergo the Acetous and if

Fermentations take place and that they mutually retard each other, that the Farina being converted into Sugar undergoes the Vinous, the Starch or Mucilaginous part the Acetous, and the Gluten the Putrefactive, but they are certainly wrong for no fermentation at all takes place - but simply a discharge of fixed Air as Doctor Pennington has proven (when Yeast is used) but the rarefaction of Atmospheric Air is sufficient, hence Snow will do as it envelops much Air - Eggs, Butter, &c - which are used in making puddings &c. act by virtue of the Air which they envelop -- The Bakers in the Summer when at a loss for good Yeast remedy the inconvenience by adding Potash to the Yeast the effervescence that ensues causes a disengagement of fixed Air which rises

the Bread – The French Bakers make their light rolls by mixing their Flour with Soap Suds – Besides fermentation never could take place in so short a time as sufficient to make Bread light – The only circumstance in favour of fermentation is that we are unable to separate the constituent parts of Bread ——

Lecture 55th –

Alkohol or Spirit of Wine is very volatile no decomposition takes place in the distillation of it. when in contact with flame it burns of a beautiful blue colour – Water is formed in the combustion of Alkohol – Mr. Lavoisier obtained 17 ℥ of Water by burning 16 ℥ of Alkohol this a proof that Water is compound of Hydrogene and Oxigene, the Hydrogene of the Alkohol uniting to the oxigene of the Atmosphere forms the Water – the Charcoal of the Alkohol unites to another

portion of pure Air and is dissipated in form of Carbonic Acid - Spirit of Wine is an Agent very much used in Chemical experiments its combinations are necessary to be known —

Aether is a combination of an Acid and Spirit of Wine (or perhaps the oxygene of the Acid) - the Vitriolic Aether is most generally used - its properties are a pungent fragrant smell it is colourless - floats on Water without mixing with it - very volatile and would always exist in a Gaseous state if the pressure of the Atmosphere did not prevent its assuming that form - It generates much cold by evaporating so great as to freeze Water, if the operation be performed under the exhausted receiver - It boils at a degree of heat equal to that of the Human body - It is very inflammable and burns like Alkohol —

Authors direct us to add equal quantities of Sulphuric Acid and concentrated Alkohol

made by distilling from Potash — distillation is to be proceeded upon — The 1st product that comes over is Alkohol — 2nd Ether — 3rd an Acid mixed with the Oil forming what is called the sweet oil of wine, if heat be applied to the residue in the Retort Sulphur and Prussian blue are produced — I know not how Ether appears to be an oxigenated Alkohol — the heat used must be very gentle or else Sulphureous gas rises along with the Ether it may however be absorbed by Water — if it require to be very pure distillation on caustic Potash several times effectually answers this purpose, the Ether as it is volatilized runs in streams along the beak of the retort, if none of these streams appear no Ether is disengaged If the Ether be combined with Water it may be known by a drop of Ink which is diffused through the Water but remains unchanged if it be pure Ether, the remainder in the retort is about the consistence of Tar and may be prevented from becoming hard, more Ether

may be obtained by redistilling Alkohol from this residue - according to Chaptal a leaden still is used for the distillation of Sulphureous Ether in the large way —

A mixture compound of 2 ℥ of Ether 2 ℥ of Alkohol and 12 drops of Etherial oil constitute the Anodyne liquor of Hoffman - this is used in irregular motions of the Nervous system Ether is mostly used now for that purpose —

How is Ether formed and what combinations take place, this is a difficult question to answer precisely, several opinions are prevalent with respect to it Beau was of Opinion that it was compound of an Acid water and oil &c - but we are not acquainted with all that passes in the operation - 1st a spirit rises - 2nd an Acid and 3rd an Oil — a more probable opinion is that the Alkohol only attracts the oxigene from the Acid and becomes oxigenated —

Nitric Acid exhibits some curious Phenomenon with Spirit of Wine, if a small

quantity be added a violent ebullition is the consequence the flavour is changed it disengages vapours of great elasticity which is a fine Ether – Another process for making Nitric Ether is to add two parts of Nitric to three of Alkohol expose it to the cold for 24 hours, an Ether rises and floats on the surface of the liquor but great caution is necessary as the vapours are very elastic – Woulfes apparatus is best calculated to distill Nitric Ether in – Dr. Black recommends a very easy method of making the Ether to add to the usual proportion of acid an equal quantity of Water, this keeps the two fluids separate and so prevents the ebullition in the operation, it is to be stood in a vial 5 or 6 days and the cork opened every now and then, the Ether rises and floats on the surface of the Water. the Vessel must not be agitated or it will infallibly burst, here no distillation is

is used - Nitric Ether may be also made by distilling Nitre Sulphuric Acid and Alkohol, the Sulphuric Acid seizes the Potash of the Nitre and the Nitric being by this means set at liberty forms Ether with the Alkohol ——

Spiritus Nitri Dulcis - Sweet spirit of Nitre is made by adding a small quantity of Nitric Acid to Spirit of Wine and distilling it —

Muriatic Ether may be made by distilling corrosive sublimate with Tin, the fuming liquor of Libavius is thus made, which is to be distilled with Alkohol and a very good Ether will be procured - Also by distilling common Salt Manganese and Spirit of wine it differs materially from Sulphuric Ether 1 the smell is as penetrating as that of the oxygenated muriatic Acid - 2nd the Taste is as astringent as that of Alum ——

Ether may be procured by the Vegetable Acids - Count Lariqua say the Acetic Acid

procured by the distillation of Verdigris answers very well to make Ether with, it affords by distillation with Alkohol a much larger quantity of the Ether than the Sulphuric Acid does – The vegetable Alkali is insoluble in spirit of Wine – ½ a pound of it is added to 9 ℔ of spirit of Wine to concentrate it, it is apt to get a yellow colour which may be separated by distillation and then we obtain a very concentrated Alkohol – Boerhaave calls it Tartarized spirit of Wine and says it dissolves all Bituminous substances – the caustic Alkali is purified by this process and may be obtained by distilling off the Alkohol in a state of great purity —

Carbonate of Ammonia unites very differently, the two fluids are converted instantly into a solid mass of a white colour – according to Boerhaave the Spirit unites to the mass of Water of the two fluids and leaves it to chrystalize the mass is called

Offa Alba Helmontii supposed a long time to have been a mere whim of Van Helmonts - the temperature of the Room influences this experiment very much - It succeeds at one time of day and fails an hour afterwards - to succeed mix Carbonate of Potash and Muriate of Ammonia a double elective attraction ensues the fixed Air of the Potash unites to the Ammonia and forms Carbonate of Ammonia while the Potash and Marine Acid unite - the ammonia used is that procured from bones the Alkohol must be pure and the temperature attended to - This constitutes the famous Miracle at Naples A pious Lady of that City caught an ounce of the blood of St Januarius, the Tutelar Saint of the City who suffered Martyrdom - it is nothing but this mixture coloured with Cochineal - when this Saint is petitioned the Priest by rubbing his hands on the Glass warms and so thaws

the Blood (which is kept solid by being kept in a low temperature) this is thought a certy that their Prayer is heard — (see Moores Travels through France & Italy — Brydones Tour &c)

Lecture 56

By distilling Alkohol from red precipitate a good Nitric Ether is procured — Alkohol has been proposed as a test for the strength of Gunpowder but it is certainly a very bad one for if much Alkohol be poured on the Powder it will not inflame whereas if it be merely moistened with it it readily does —

Eau de Luce is made by dissolving lie of Amber in recti Spirit of Wine and pouring it upon Caustic Ammoniac (see Nicholsons Chemical Dictionary) it precipitates a milky white colour owing to the Alkohol not uniting to the lie — Alkohol decomposes saline solutions and is

hence of use in Mineral Waters - the Sulphuric Salts are most difficult, Nitrates carries —

Alkohol acts feebly on the calces of Metals, it separates Gold from Aqua Regia Alkohol is used to clean gold and Silver Lace - the Alkaline Salts destroy the Lace and cannot be used, a brush is wet with Alkohol and rubbed over the lace the Artists conceal the Spirit by various Methods - Stains may be taken out of Silk by Spirit of Turpentine, this leaves a small stain behind and is effectually removed by Alkohol - Spirit of Wine has a strong affinity for Water —

Animal Substances.

The soft and white parts of Animals as Tendons Cartilages Ligaments Muscles &c - contain a mucilaginous substance called Jelly - which is procured by boiling them and evaporating the Decoction, exposed to a more

violent heat they afford Glue, this substance is generally procured by boiling the clippings of Hides, hoofs horns &c of Animals - the Jelly is much less viscid than the Glue - Glue is generally procured from old Animals, Jelly from Young ones - by distillation they yield, first a Water which readily putrefies - 2d an Oil - & 3rd Volatile Alkali —

Bones distilled afford an Inflammable Oil - Water and Volatile Alkali - the Oil is of a very black colour, the residue is a coal of difficult incineration, a white mineral part remains behind which consists of the Phosphoric Acid and Lime, Acids decompose it (vide phosphorus) - Animal Putrefaction - In order that these Animal substances may putrefy, Air, heat rest and moisture are requisite - Volatile is the first product of putrefaction, also a penetrating volatile substance which has not yet been properly examined, to obtain it

Beef must be exposed in a vial to the air and suffered to putrefy, neutralize the Ammoniac by an Acid, when the other Gas is very distinctly smelled - Doctor Mitchell supposes it to be Nitrous Acid. Lime Juice neutralizes it completely, cold air also acts powerfully upon it - Putrefaction is owing to the Water contained in the Beef - the oxigene of the Water unites to the Azote of the Animal substance and forms Nitrous Acid while the Inflammable air unites to another portion of the Azote and forms Ammoniac - An oily part also remains and a substance resembling Spermaceti - this was known to Lord Bacon - Worms are adventitious and owing altogether to the deposition of Eggs by Flies during the putrefaction of the Meat —

Bodies buried under the surface of the Earth putrefy much slower - as their putrefaction is retarded by the dryness of the Air - dry Earth absorbs the Moisture and so prevents that process - Antiseptics

prevent it, but how I cannot say — the only Salt I have ever found decomposed in putrefaction is Alum and that only by parting with its excess of Acid — Sea Salt and Glaubers Salt in small quantities hasten, but in large retard putrefaction —

Lecture 57th

Bones when exposed to heat inflame in consequence of an oil which they contain if distilled they afford 1st Water — 2nd a black fœtid Animal Oil and 3rd Ammoniac — this Mr. Lavoisier thinks is owing to the combination of the Hydrogene of the bones and the Azote, but I think the Azote comes from the Atmosphere, for if we distill bones and lute a Receiver on the end of the Refrigeratory nothing but a transparent Gas is seen but when the luting is broken so as to admit the Atmospheric Air large quantities of Alkaline Gas are obtained ——

Milk is a white liquor secreted in

the Breasts of Female Animals for the nourishment and support of their Young it is a bland Opaque fluid about the consistence of Water —

Milk upon exposure to the Air undergoes the Spiritus fermentation which is quickly followed by the Acetous, it coagulates by means of the Acid thus evolved and forms a mass called Bonny Clabber by the Vulgar, this soon separates into a serous or watery part and a thicker substance consisting of Oil and Mucilage — The aqueous part or Serum affords by evaporation a true Sugar —

All the Acids coagulate Milk, Wine coagulates it in proportion to the Acid it contains — if heated to ebullition the coagulation is much more readily effected, hence in making Wine whey the Milk is boiled before the Wine is added — Boiling fresh Milk prevents or retards its Acetous fermentation —

The Neutral Salts and Alkalis have no action whatever in coagulating Milk — the

Alkalis form a Soap with the Butter the properties of this Soap have not yet been examined —

If the Serum be evaporated and Potash added to it a Neutral Salt is obtained, according to Scheele by its combination of the Saccholactic Acid —

Various substances are used to coagulate Milk for the purpose of making Cheese the Stomach of Calves is most frequently used it is called Runnet, some suppose that it acts by containing an Acid, but no Acid can be detected in it — Some Authors have asserted that the Stomachs of Herbivorous Animals alone coagulate Milk, but this is false, for the Stomach of Carnivorous Animals have been used with equal advantage — Besides the Stomachs of Skinks i.e. Calves in utero, who have never tasted vegetable food of any kind, coagulate Milk as readily as those of full grown Calves — The Liver and Heart of the Turkey — Muscle of Fowls

or Animal of any sort, are all endowed with this coagulating property — some even assert that living Fish if put into Milk will coagulate it, but they lose this property after Death, how this is I do not know various vegetables also coagulate Milk as the Galium Luteum or Yellow Lattice bed straw. the Rubia Tinctorum or common Madder. the Cross Wort. Artichoke, Claws of Cardui and very many others. these are put into warm Water first and then into the Milk which soon coagulates —

Milk is composed of three parts, the Oily or Cream — the Mucilage or Cheese and the Serum or Water, the mucilage is destined to keep the other two parts in a state of union —

1st Cream this rises and floats on the top of the Milk after it has stood at rest for a considerable time. this by agitation in a Churn affords Butter —

by becoming deprived of all its mucous parts the separation of the Cream (which floats like all unctuous oils) takes place in Vacuo as well as in the open Air, neither Acids nor Alkalis prevent this separation if the Milk be left at rest and undisturbed – the mucilage and Serum afterwards separate, the white part is called the Curd the aqueous the Whey this Curd requires only pressure to convert it into Cheese by expelling its Water —

Milk yields different quantities of Cream in proportion to the richness of the Pasture on which the Animals feed – hence in May and June when the Grass is best Cows yield most Cream, and hence Cows which feed on Pasture which has been left unplowed for several Years always afford much Cream as the Pasture is very rich – The longer Cream is left before it is churned the more readily it is turned into Butter provided it does not absolutely putrify – hence in Devonshire no Churns are used, they suffer their Cream to stand so long that the agitation by

their hands is sufficient to effect the separation of the Butter —

Butter contains a small quantity of the Cheese or Mucilaginous part and hence is liable to rancidity if exposed to the Air, by the fermentation of that mucilage, this may be prevented and remedied by washing the Butter in Water – The separation of Butter takes place most readily in a temperature of from 78° to 100° Farenheit, Potash forms a Soap with Butter of a thick unctuous consistence – 4° of heat are generated by the agitation used in churning Butter —

2nd Cheese or Mucilage four pound of Milk yield about four ounces of Cheese – the Cheese procured from Milk is influenced by several circumstances

a. The richness of the Pasture on which the Cows feed, the excellency of Parmesan Cheese is owing to a rich slime which is deposited by the River Po on the Meadows where the Cows

feed this time enriches the Pasture very much

b. The quatity of the coagulating substance has some influence on the Cheese, some use Annotto but the chief use of it is to give a reddish colour to the Cheese —

c. Whether New or Skimmed Milk has been used in making the Cheese, in Gloucestershire the fresh Milk is used, in this County it is common to skim the Milk they manufacture so much Cheese in Gloucestershire from new Milk that a Traveller who passes through that place, tho' it is a land flowing with Milk can scarcely procure any Butter — those Cheeses which are made from pure Cream have nearly any consistence, they are much more unctuous and greasy than the others —

d. The manner of preparing it, this has a very great influence on the result, to enumerate the various methods now in use would consume quite too much of our time —

e. Climate — Those who make such good

Cheese in England if they remove from their own Plantations cannot make any other than ordinary Cheese —

3rd Serum or Aqueous part this remains after the Mucilage and Oil are separated, to procure it in a state of purity all the Cream must be separated from it, Runnet is added which coagulates the Cheese, It mostly contains some of the Mucilage and Oil, the Serum consists of little else than Sugar and Water, to obtain the Sugar of Milk the whey must be evaporated to the consistence of Honey when cooled it concretes into the Sugar of Milk, but if it be wanted in a state of purity, this mass must be dissolved in Water and chrystalized by evaporation before the evaporation is quite finished the solution must be clarified by whites of Eggs, and the solution being cooled shoots into chrystals which are soluble in three times their weight of Water — if the chrystals are burned they afford Potash and

Muriate of Potash — Nitric Acid converts this Sugar of Milk into the Oxalic Acid —

The Milk of different Animals afford different quantities of this Saccharine matter

4 ounces of the Milk of an Ass yields	— 84 grains Sugar of Milk
4 oun. of Human Milk	— 64 —
4 — of Mares Milk	— 70 —
4 — of Cows Milk	— 54 —
4 — of Goats Milk	— 49 —
4 — of Sheeps Milk	— 35 —

In general the Milk of Herbivorous Animals afford more Sugar than that of Carnivorous, the first are subdivided into Ruminant and non Ruminant Animals, the ruminant are Sheep Goats and Cows, the Non ruminat Women Asses and Mares, the Milk of the latter afford most Sugar —

Men sometimes have Milk especially when Young from 3 days to 9 years old — Women also have it often before they have borne Children — An ignorance of this last mentioned fact has been the source of much

Mischief - in Scania a Province of South Gothland, when a Child was found Murdered it was customary to assemble the Young Women near the spot and try whether any of them had Milk in their Breasts, if so they were adjudged Guilty, if not they were acquitted —

Cows Milk is the only one which possesses all the properties we have been taking notice of, the Milk of different Animals differs from it in some few respects, Goats Milk is much more white than Cows - Sheeps Milk contains double as much Oil and Mucilage in proportion to its Serum - consequently affords more Butter and Cheese - Goats Milk is much more difficult to churn and yields less butter than either Sheeps or Cows - A very remarkable peculiarity of Sheeps Milk is that of being coagulated by Alkohol and separated into its three constituent parts — Womens Milk differs from Cows in not being coagulated by Acids, but if left at rest in a temperature about 96° it coagulates in a few

Minutes - Womens Milk is less changed by diet than Cows &c - this is a disputed point Women labouring under Syphilis do not communicate to Children who suckle them A spontaneous separation of the Cheesy and other parts of the Milk takes place in the Stomachs of Children, this they very frequently puke up - According to Doc. Fearis Globules of Mummy have been found in the Milk of Persons using that Medicine He adds that Milk has been tinged yellow when Women have been using Saffron Red by Rubia Tinctorum, that it is also coloured by Treacle, Mustard &c - and that the peculiar fetor of Cabbage has been smelled in the Milk of Women who have used it - Asses Milk if left at rest for a short time in a warm place separates into its three constituent parts, Serum which lies between the Mucilage and the Butter which floats on the surface - Mares Milk

is similar to Ayes in most respects its colour is more Yellow, it is coagulated by Acids as the others — (for further particulars Refer to Young De Lacte and Fears) —

Fat, is a whitish concrete oily substance which exists in various parts of Animals which varies in colour according to the age of the Animals from which it is procured Infants have their Fat perfectly white young Men of a more yellow colour and old people perfectly yellow — it differs in consistence according to the Animals from which it is obtained Graminivorous have more solid Fat than Carnivorous Animals — It differs 3rdly with regard to the part from which it is procured, near the Kidneys is is hard and solid, under the skin more soft and unctuous and between the Muscular Fibres quite oily — It differs 4thly According to Fearon it is harder in cold weather than in Warm —— Fat contributes much to the support of Animals as is seen in the

Bear Marmoth and Dormoth and all hibernating Animals which live all the Winter without Food —

To procure Fat in a state of purity it must be cut into small pieces, as much of the Cellular Substance as can be conveniently is to be separated and the Fat then boiled in a Pot containing some Water which prevents the Empyreuma which the Fat would acquire unless this precaution were used, while perfectly fluid it is to be strained through a linen cloth and it concretes into a solid mass by cooling —

By heat it smokes and inflames, if distilled in a Retort it affords 1st Flegm or Water - 2nd An Acid and 3rd A liquid Oil, and indeed Fat appears to consist of an Oil rendered solid by its union to this Acid, we are indebted to Cull for a particular account of this Acid, he saturated the vegetable Alkali with it and obtained a Salt in chrystals of a dirty brown colour

5

this colour is owing to the Oil which it contains, to purify these Crystals he directs to burn them by throwing them into an ignited Crucible, by this means the Oil is dissipated - A solution of Potash is next added, this dissolves the crystals and is to be evaporated and uncrystalized, this crystalization and solution are to be repeated several times, when the pure Sebate of Potash is procured, to seperate the Potash Sulphuric Acid is added which forms with it vitriolated Tartar, the proportions are 10 ℥ of the Crystals and 4 ℥ of Sulphuric Acid, this distilled by a gentle heat affords 2 an ounce of an acid fuming Acid, this Acid is called the Sebacic - one pound of Suet contains about 3½ ℥ of this Acid, it possesses the general properties of the Acids, its neutral Salts are called Sebates —

Sulphuric Acid added to Fat blackens it and emits fumes —

Nitric Acid emits Nitrous gas and if sufficiently concentrated inflames Fat —

According to Cell the Sebacic Acid ignited by heat dissolves some of the Metals but has no action in the Cold —

Fat acts on the calces of the Metals by abstracting their Oxigene and becoming rancid - Calces of Lead Copper Mercury and some say Iron are revived by being heated in contact with Fat - for a particular account of Cells experiments, who has made some valuable experiments on this subject, I refer to the volume of the London Philosophical Transactions for 1782 - 83 —

Lecture 58th —

The Blood is a more or less bright red fluid of an unctuous and somewhat viscid consistence which circulates in the Arteries and Veins of living Animals and serves the important purpose of affording them Nourishment —

Blood if left at rest separates into two parts the one serous or watery denominated Serum the other dense and coagulated and usually floating on the surface of the Serum denominated

Crassamentum this is of a red colour, the Serum perfectly or nearly transparent, its colour is slightly greenish or yellowish its taste saline the Serum is not pure Water it is coagulable by heat and forms a substance much resembling the White of an Egg it differs from this however in being soluble in Water

The Blood readily putrefies it then affords a blackish fetid Oil, Ammoniac and a Carbonaceous substance. the Ammoniac is very readily smelled in putrid Blood the Coal is of very difficult incineration the Salts which give the Blood its saline taste appear to be Soda - Common Salt and Phosphate of Lime ——

The Serum readily runs into putrefaction if exposed to the Air, yielding then by distillation Ammoniac, a water which also readily putrefies, tho' it is no more putrid when first procured and a phosphate of Lime the Serum coagulates by being gently heated in a spoon or if thrown into hot Water

M. Brugnat

The Mineral Acids coagulate the Serum in the same manner as they do Milk this they are supposed to do by uniting with the Salts that are said to keep it in a fluid state, Alkalis under them more fluid which under this opinion somewhat probable, Alkohol coagulates it by uniting to its Water —

The Crassamentum consists of two very different substances - Red Globules & Coagulable Lymph. the ingenious Plenck has founded a Theory of the difference of Temperaments on the difference in quantity of the different parts of the Crassamentum - if the Carbonaceous principle is abundant the Melancholic Temperament is produced, if the red Globules the Sanguineous - if there be too much Bile (which he thinks exists in the Blood) he says the Choleric is the consequence —

The Red Globules contain much Iron which gives them their Colour, if the Crassamentum of the Blood be separated into its red Globules and Coagulable Lymph by washing

(the Lymph being made white by washing of course the red globules exist in the Water and may be procured by evaporating the Water) and these Globules burned in a Crucible affords a powder which is attracted by the Magnet and is Iron - 25 lbs of Blood contain Zij of Iron

By distilling the Crassamentum it affords, Water which readily putrefies, and affords Ammonia by putrefaction, if the heat be increased a thick black bile comes over, and the residue in the Retort consists entirely of carbonaceous matter not easily reduced to Ashes - If it be burned and the Ashes lixiviated, Iron is obtained and a calcareous Phosphate - this Iron exists exclusively in the Red Globules, not a particle can be detected in any other Part of the Blood Iron may be detected in the Urine of Persons who have taken it by the common tests ——

A dispute has arisen among Physiologists whether Bile does or does not exist formally in the Blood - De Fourcroy declares from his experiments that it does - he took six pound of Oxens Blood and added to it three pound of Water

this Water in which the Blood had been digested was filtered, and a greenish substance remained on the Filter about the consistence of an extract. it had the peculiar smell of the Bile, taste colour &c – and in short all its relations to the different objects of Chemistry were precisely the same as those of the Bile it was the Bile itself – Hallers doctrine is that no secreted fluid can exist in the Blood and of course is opposed to Fourcroys assertion –

To return – Plenck has experimented on the Halitus or steam which constantly flies off from fresh drawn blood, he says it consists principally of Carbonated Hydrogene Gas or what he calls Animal Gas – by exposing it to an Atmosphere of Oxigene Gas under an inverted Vessel a formation of fixed Air is perceived which is owing to the Oxigene uniting to the Charcoal which the hydrogene holds in solution ——

Bile – is a fluid secreted in the Liver and deposited in the Gall Bladder of the more perfect Animals. its principal use is in

Digestion, it is of a greenish yellow colour, very bitter taste and peculiar unpleasant smell - of a more or less slimy and viscid consistence, like a thick solution of Soap in Water rather thicker than Blood - Fourcroy says that Water left in contact with Bile for a few days contracts a smell resembling musk or Amber - If distilled, Water comes over first, the Bile acquires a thicker consistence and if all the Water be evaporated a dry mass is obtained which attracts moisture from the Air, and is perfectly soluble in Water - If the heat be further urged a volatile Aromatic Oil comes over, An Animal Earth, Coal and Iron constitute the residuum in the retort - the Coal is of very difficult incineration; if the Ashes of it be boiled in Water a kind of Soap is obtained - If Acids be added to this Soap it is decomposed, the Acid and Alkali unite and leave the Oil, so that the Bile may be considered a true Animal Soap - very probably this Alkali causes the Bile to turn blue vegetables green ——

The Metallic solutions decompose the Bile

and form Metallic Soaps with it — whether the Bile does or does not exist in the Blood is a disputed Point experiments are wanting to determine the Point —

Saliva is another secreted fluid, nearly insipid of a viscid consistence and whitish colour - secreted in the Mouth of Animals to assist in Mastication and Digestion - If Lime or Caustic Alkali be digested in the Saliva, a smell of volatile Alkali is perceived, it may therefore be considered as containing an Ammoniacal Salt - Sir John Pringle considers it as a Powerfull Septic - Spallanzani and others as an Antiseptic - Experiments are wanting to determine this fact —

Gastric Juice is a fluid found in the Stomachs of most Animals, its most remarkable property is its Solvent Power, it dissolves almost all substances Animal and Vegetable and the Stomach itself after Death, Bones Gristle, tendons, ligaments - every Animal substance yields to its Solvent Power —

It is procured by causing an Animal to fast and then killing it, in this manner Spallanzani procured 37⅔ from one Sheep, he asserts that it is a powerful antiseptic Fourcroy denies this and says it disposes to putrefaction – experiments are wanting here –

Its solvent power is so truly astonishing that it has been known to dissolve Silicious Earth and even the Diamond itself –

Sweat – is an excretion from the surface of the Bodies of Animals destined to carry off their excess of heat by its evaporation – it also is of use in preserving the pliability of the Skin – Muriate of Ammonia exists in it, and may be smelled if the hands are washed in a solution of Potash – Its colour is yellow, its taste saline, and smell unpleasant – by analysis it affords the Phosphoric Acid sufficient quantities cannot be procured readily for experiments ———

Urine is a secretion of the Kidneys which is deposited in the Bladder, it is

divided into two sorts 1st that which is voided soon after drinking and is called Crude Urine or Urina potus, this is nearly insipid inodorous and possesses few of the properties of the other, it appears to filter through the Stomach into the Bladder without going through the sort of the circulation, the quick voiding it after drinking certain Mineral Waters, after the use of Nitre &c. all conspire to prove this — The other or Concocted Urine is a secretion from the Blood which is performed by means of the Kidneys — Its taste is saline, colour yellow, inclining to red — smell unpleasant and fetid — It contains a disengaged Acid which reddens Litmus — this Acid is the Phosphoric — If Urine be evaporated to the consistence of a Syrup — crystals of a Salt are obtained which consist of Phosphate of Soda, and Phosphate of Ammonia called also fusible Salt — Microcosmic Salt &c &c. — Its principal use is as a Metallic flux ———

Ear Wax — The Wax of the Ear is a

peculiar substance whose use appears to be to prevent the access of Insects to the Organ of Hearing - its colour is a yellowish red much resembling that of Copper, its consistence that of Beeswax about half fluid which varies much, its taste is very bitter owing to bile which exists in it according to Marquer - its nature appears to be Bily but is not perfectly so - when gently heated an Acid is emitted, and a Carbonaceous matter remains united to some Bile —

The Ear Wax burns like resins, but is not soluble in Alkohol, it is perfectly soluble in Water consequently Water should be used in all injections for the Ear

Acids & Alkalis -

It has no action on the Metals —

Lecture 59th —

Mineral Waters

The analysis of these is a difficult

Problem for the Chemist, to make a perfect analysis it is necessary to be aware of the distinctive characters of all substances which may be held in solution by the Water — To separate from an almost imperceptible residue the various substances which compose it, to appreciate the nature and qualities of the substances carried off by evaporation and to ascertain whether certain products are not formed in his operations and others decomposed —

To form an opinion of the nature of a Mineral Water the Chemist should possess accurate information, concerning the place where the Water exists — What is the nature of the Soil — the stones and Minerals which lie near the Spring — the temperature of the spring should be determined by a Thermometer, enquiry made whether this temperature is influenced by Rains or not — whether Rains dilute much the strength of the Water, whether any Metallic ores exist near it — In short every circumstance which is in the

least connected with it ——

Sulphuric Acid is very often found in Mineral Springs it is detected by its taste and Acid properties, but much more accurately by muriatic Barytes, this substance is instantly decompond by Sulphuric Acid and Sulphates of Barytes formed one drop of Sulphuric Acid may be detected tho' diffused in a Gallon of Water

It was long thought that Lime is insoluble in Water unless in the state of Quicklime - but modern Chemistry has taught us that Lime with an excess of fixed Air is as soluble in Water as quicklime, hence Lime is more soluble in Mild Alkaline solutions, as the Alkali yields its fixed Air to the Lime — Lime is detected 1st By its flat insipid taste and whitish colour 2nd By volatile Alkali 3rd By Sulphuric Acid which forms Selenite (this Acid also detects Alumine forming Alum with it and Magnesia forming Epsom Salt) - 4th By Carbonic Acid with which it forms an insoluble compound ——

5th – The most accurate test is the Oxalic Acid which forms an insoluble Oxalate of ~~Potash~~ Lime or essential Salt of Lemons answers equally well –

Of the Inflammable substances sulphur is the only one found in Mineral Springs excepting fossil Oil – We know that Sulphur is insoluble in an Aqueous Menstruum, how then can it exist in Water – by being previously dissolved in hydrogene gas, constituting Sulphurated Hydrogene or Hepatic Air, or else the Water contains Alkali and it forms with the Sulphur – Hepar Sulphuris ——

Of the Metals Iron and Copper are soluble in Water, when we consider the circumstance that Iron is daily uniting to Water (by rusting) it is surprising that it was so long a secret to Chemists that this Metal is soluble in Water ——

The presence of fixed Air assists the solution very much – Iron is detected 1st By Gallic Acid – 2nd By the Precipitate of Lime or Potash – the first turns the solution to a deep black colour, the second

of a beautiful blue colour forming Prussian Blue, the best mode of preparing the Gallic Acid is to digest the Galls in Alkohol - as the Aqueous infusion is apt to mould the Prussiate is the most accurate it detects the 24th part of a grain of Iron diffused in three pounds of Water - 3rde By agitating whites of Eggs in it, which become of a yellow colour - 4the By Nitric Acid which deposits a White precipitate ——

Copper is detected 1st By its blue or green colour - 2nd By a deposition of a red colour on a polished Key or other polished piece of Iron 3rd By Volatile Alkali which turns the solution to a deep blue colour, if more be added Cuprum Ammoniacum is formed - Caustic Alkali must be used, the best mode is to cause the Alkaline Air to pass through the Mineral Water - the Carbonated Alkali is a test for Magnesia and Alumine ——

It is a disputed point whether Ammonia can exists in Mineral Waters - it may be possible tho' we have no proofs of it, the method of detecting it is to evaporate the Water

and place the uridum between two polished plates of Copper and heating it in this situation the Copper is undered white by Arsenic — also by throwing the uridum on hot coals or Iron when a smell of Garlic will be perceived Also by the addition of Cuprum Ammoniacum which is turned from a blue to a green colour —

The Neutral Salts very often exist in Waters — Muriate of Soda is detected by the Nitric solution of Silver which forms a Luna Cornea with it, this test is very accurate — all the pump water of this City affords this precipitate

Vitriolic Ammoniac — Borax. Nitre, are never found in Mineral springs but in Cities Nitre is frequently detected — Nitre is deposited in the Wells of our City by the Rains filtering through Grave Yards &c — where Animal putrefaction goes on — the Earth at the bottom of the Graves is always very Nitrous — Mr Hunter an Apothecary of this City has analysed some Water from a Pump near St

Pauls Church Yard and from 220 Gallons of it procured by evaporations

12 ⅔ of Lime
18 ⅔ of Magnesia
24 ⅔ of Common Salt
32 ⅔ of Nitre —

A pump near the corner of Second and Chermet Streets contains a considerable quantity of Selenite – this and Alum are almost the only Earthy Salts found in Mineral Springs

Gypsum is detected by the tests for calcareous Earths, also by evaporation and the addition of Alkalis which turn it of a muddy opaque colour, and indeed the Waters which contain it are seldom perfectly clear —

Alum is detected by the addition of Alkalis also and blue vegetable colours which it turns red by its excess of Acid —

Of the Metallic Salts Sulphate of Copper, Iron and Zinc usually exist in Mineral Waters, Mercury never exists in them Blue Vitriol is detected by the tests for Copper

Green Vitriol by the tests for Iron, & White Vitriol by Blue vitriol which it changes to a white colour, this happens by the stronger affinity which the Acid has for the Copper, it forsakes the Zinc which is precipitated

The presence of fixed Air is detected in Water by a taste Sui Generis - 2nd the addition of Lime Water which is rendered turbid - 3rd By its brisk motion when agitated - 4th By caustic Volatile Alkali 5th By agitation and then holding the flame of a Candle over it which goes out 6th By half filling a bladder with it and putting it into boiling Water its Air is disengaged, in this way the exact proportion may be ascertained, the Air is also disengaged by gentle heat in a Retort

Hepatic or Sulphurated Hydrogene gas is known by its smell of rotten Eggs Bergman first observed it in Mineral Waters, if left long at rest the inflammable

Air is disengaged and may be burned on the surface of the vessel – Nitric and Oxigenated Muriatic Acids precipitate the Sulphur this happens by their Oxigene forming Water with the Hydrogene of the Hepatic Air, this is a discovery of Scheeles ——

With this Gentlemen we finish our Course of Chemistry – and I bid you all an affectionate farewell ——

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